APRIL, 1934.

GENERAL PHYSICS.

ADSORPTION.

1370. Adsorption and Capillary Condensation. A. A. Schuchowitzki. *Kolloid Zeits.* 66. *pp.* 139–147, *Feb.*, 1934.—On the basis of the potential produced by the adsorbent and the intermolecular forces of the adsorbate, a method is evolved for the depiction of the intermediate region of vapour adsorption. By means of an approximate evaluation of the magnitude of the adsorption potential, comparison may be made between the results of different adsorption experiments. In limiting cases, the method approaches Polanyi's theory and the theory of capillary condensation. The experimental data are in agreement with the simplified equation, $Q_1 = \log Ps_1/Pi_1 : \log Ps_2/P_2$, where Ps_1 and Ps_2 are the vapour pressures of the saturated vapour of the adsorbate at temperatures T_1 and T_2 respectively and P_1 and P_2 are the equilibrium pressures which, at T_1 and T_2, correspond with equal volumes of liquid taken up. The regularity observed by Kubelka [see Abstract 3256 (1931)] in the volume characteristic curves for charcoal is shown to arise from the fact that, in the capillary condensation theory the adsorption potential is not considered. T. H. P.

1371. Adsorption and Quantity of Adsorbent. Part II. T. P. Papkova-Kwitzel. *Kolloid Zeits.* 66. *pp.* 148–155, *Feb.*, 1934.—The dependence of the total and specific adsorptions on the quantity of adsorbent has been investigated for the systems acid violet-negative $Al(OH)_3$, acid violet-positive $Al(OH)_3$, acid violet-SiO_2 and methyl violet-SiO_2. The relation between x and m [see Abstract 1666 (1933)] can be expressed by the equation $x = km^{\frac{1}{n}}$ only in the region of sufficiently high quantities of adsorbent; for smaller values of m anomalies appear. In the system acid violet-negative $Al(OH)_3$, as m is diminished x rises to a maximum, then falls, rises to another maximum and again falls. For these anomalies an explanation, based on dispersion, dehydration and coagulation of the adsorbent, is given. The $x : m$ curve for the system methyl violet-SiO_2 shows only one maximum, which corresponds with a maximum on the $x/m : m$ curve. These anomalies depend on diminution of the charge by adsorption, with a resultant marked coagulation effect, and also on dehydration. T. H. P.

1372. Tenacity of Active Carbons for Vapour. Part I. F. Krczil and H. Wejroch. *Kolloid Zeits.* 66. *pp.* 155–163, *Feb.*, 1934.—The methods for determining the tenacity of active charcoal for vapour and an arrangement for use with the dynamic method are described. Three carbons activated by diffusion gas and one by zinc chloride have been examined. The amount of benzene expelled (calculated on the amount required for saturation) increases with the initial charge and is at first very large, subsequently diminishing continuously—more rapidly when the initial charge is high. For different initial charges, the percentage amount of benzene retained by the carbon when air is passed through is dependent on the initial charge only at the beginning of the expulsion, and from a certain point, characteristic for the particular product, becomes independent of the original charge. The amounts of benzene retained by 100 gm. of different carbons are not in the same order as those retained by 100 c.c. No relation is apparent between the absorptive power and the tenacity of a carbon for vapour. T. H. P.

1373. Adsorption of Hydrogen Sulphide by Activated Alumina. C. H. Bayley. *Canad. J. of Research*, 10. *pp*. 19–23, *Jan*., 1934.—Measurements have been carried out on the adsorption of H_2S on a commercial sample of "activated alumina" by the dynamic and static methods. The adsorption is influenced by prior heating of the alumina to various temperatures, being a maximum when the temperature of prior heating is 550° C. AUTHOR.

1374. Adsorption of Gases at Solid Surfaces at Low Pressures. C. Zickermann. *Zeits. f. Physik*, 88. 1–2. *pp*. 43–54, *Feb*. 21, 1934.—The adsorption isotherms of N_2 and A on mica and glass have been measured at temperatures between 77·7°–90·2° Abs. over the pressure range of 10^{-5} to 5×10^{-4} mm. At pressures between 1·5 and 3×10^{-4} mm. the amount adsorbed is a linear function of the pressure, but at lower pressures this relation no longer holds. The departure from linearity is attributed to the existence of active centres which form about 1 % of the surface. The heats of adsorption calculated from temperature coefficients are N_2/mica, 1830 cal.; N_2/glass, 337 cal.; A/mica, 571 cal.; A/glass, 125 cal. F. J. W.

1375. Gas-Solid Equilibria. Part V. Pressure-Concentration Equilibria between Silica Gel and O_2, N_2 and $O_2 + N_2$ Mixtures at 0° C. B. Lambert and D. H. P. Peel. *Roy. Soc., Proc.* 144. *pp*. 205–225, *March* 1, 1934.—A study of the adsorption by silica gel from mixtures of O_2 and N_2 (approx. 1 : 1) has yielded remarkable results. The adsorptive power of the silica gel for oxygen is, in the presence of nitrogen, actually greater (up to 15 %) than when oxygen alone is present. On the other hand, the adsorptive power of the gel for nitrogen is less in the presence of oxygen than when nitrogen alone is present. The total amount of gas adsorbed from the mixture is always slightly less than the sum of the separate amounts of the pure gases adsorbed singly at the same pressures. [For Part IV see Abstract 3959 (1932).] AUTHORS.

1376. Linear Phenomena. Part II. B. A. Talmud. *Phys. Zeits. d. Sowjetunion*, 4. 5–6. *pp*. 854–860, 1933. *In German*.—The linear adsorption isotherms of fatty acids (formic, propionic, valeric, capronic and caprylic), amines (hexylamine, heptylamine), and alcohols (butyl, hexyl, heptyl and octyl) have been measured and investigated with respect to diethylcellulose in continuance of previous work [see Abstract 1245 (1933)]. The saturation of linear adsorption occurs much earlier than that of the surface layer. There exists for linear adsorption a relationship which is similar to the Traube rule, but is much more definite. H. H. Ho.

1377. Effect of Sorbed Water on Asbestos and Other Fibres, with Special Reference to Resilience. L. M. Pidgeon and A. van Winsen. *Canad. J. of Research*, 10. *pp*. 1–18, *Jan*., 1934.—It has been shown that relative humidity exerts a definite effect on the physical properties of a mass of asbestos fibre. A special apparatus has been devised in which a mass of fibre may be compressed in such a way that the volume, pressure and relative humidity of the sample are known at any time. The effect of sorbed water on asbestos is to increase the apparent density and to decrease compressibility and resiliency. It has been assumed that the major factor which controls these characteristics is the fact that sorption of water affects the surface in such manner that the slippage of the fibres over one another is facilitated. Since no fibre unit is experimentally obtainable in the case of asbestos, the fibre bundle must be considered and the stiffness of such a bundle depends on the ease of slippage of its components and hence on relative humidity. This fact is of prime importance in the testing of asbestos where humidity will exert a direct effect on the screen test. Cotton and wool fibres have been examined, and a definite effect of humidity demonstrated. Certain theoretical speculations in the case of cotton have been put forward. AUTHORS.

1378. Sorption of Dyes by Cotton. G. L. Clark and Julia Southard. *Physics*, 5. *pp.* 95–100, *March*, 1934.—X-ray diffraction patterns of aqueous solutions of the oxazine dye, Nile blue sulphate, yield direct evidence of a varying molecular association as a function of concentration, which was previously indicated by Cohen's potentiometric and spectrophotometric data. Solutions of the order of $10^{-6}\,M$ approach obedience to the laws of dilute solutions; in moderate concentrations of the order of $5 \times 10^{-4}\,M$ the dye molecules associate to micellar structures; and in concentrated solutions the association proceeds to the stage of precipitation. The largest change in the value of the identity spacing d corresponding to the inner edge of the principal diffraction halo is found to begin with about $10^{-4}\,M$ solutions. An attempt is here made to measure pore sizes in cotton fibres from the relative absorbability of the dye from its solutions.

AUTHORS.

See also Abstracts **1465, 1471, 1644.**

ATOMIC AND MOLECULAR STRUCTURE.

1379. Artificial Disintegration Using a Ra (B + C) Source. G. Ortner and G. Stetter. *Akad. Wiss. Wien. Ber.* 142. 2*a*. 9–10, *pp.* 493–508, 1933.—The modifications necessary in order that protons may be counted by a valve counter in the presence of strong γ-radiation are discussed and experiments are described which indicate how this result may be achieved. The principal modifications necessary are concerned with the design of the ionisation chamber. This is coated with paraffin wax and has a small diameter central electrode. A filling of pure nitrogen is used to reduce the ionisation produced by the electrons. Points in the design of the amplifier which is used in conjunction with the ionisation chamber are also discussed. The improved apparatus is liable to confuse fast protons with random fluctuations due to the γ-radiation and methods of allowing for this effect are described. J. E. R. C.

1380. Artificial Production of a New Kind of Radio-Element. F. Joliot and Irène Curie. *Nature*, 133. *pp.* 201–202, *Feb.* 10, 1934.—The authors find that when Al, B and Mg are irradiated with Po α-rays, the emission of positrons continues after the removal of the active preparation and decays exponentially, with half-value periods of 3 min. 15 sec., 14 min., 2 min. 30 sec., respectively. The nuclear reaction ${}_5B^{10} + {}_2He^4 = {}_7N^{13} + {}_0n^1$ is proposed for B., ${}_7N^{13}$ being the radioactive nucleus which emits positrons, giving a stable nucleus ${}_6C^{13}$. In the case of Al and Mg the radioactive nuclei would be ${}_{15}P^{30}$ and ${}_{14}Si^{27}$ respectively. The Al positrons seem to form a continuous spectrum similar to the β-ray spectrum. Chemical experiments are cited which prove the occurrence of artificial transmutation and the capture of α-particles in the above nuclear reactions. W. E. P.

1381. Disintegration of Deutons by High Speed Protons and the Instability of the Deuton. G. N. Lewis, M. S. Livingston, M. C. Henderson and E. O. Lawrence. *Phys. Rev.* 45. *pp.* 242–244, *Feb.* 15, 1934.—To obtain evidence of the instability of the deuton and the low mass of the neutron, the authors compared the effect of proton bombardment on pairs of targets containing ordinary and heavy hydrogen. In all cases an excess of long range protons was obtained from the targets containing H^2. These are attributed to the disintegration of the deuton by the bombarding protons. The range of the protons so obtained agrees with that calculated from the masses and energies involved, on the assumption that the mass of the neutron is nearly unity. AUTHORS.

1382. Hydrogen Isotope and Heavy Water. R. Frerichs. *Naturwiss.* 22. *pp.* 113–118, *Feb.* 23, 1934.—In this comprehensive review of the subject the discovery of the isotope H^2 and its presence in the Balmer series is first dealt with, following which comes an account of its preparation, properties, and uses. The spectra shown include the fine structure of the lines $H^1\alpha$ and $H^2\alpha$, the band spectra of the molecules H_2, H^1, H^2, H_2^2, and the mass spectrograms of the negative ions of H^1 and H^2. Heavy water, the oxygen compound of the new isotope H^2, is then described and a table is included of some of its properties, *viz.*, maximum density, 1·059; freezing-piont, + 3·8°C; normal boiling point, 101·42° C.; and vapour pressures of H^1H^1O compared with H^2H^2O. The importance of heavy water in biology is discussed. A comprehensive Bibliography completes the paper. H. H. Ho.

1383. Heavy Hydrogen. *Roy. Soc., Proc.* 144. *pp.* 1–28, *March* 1, 1934.—A record of a Discussion held before the Royal Society. In the opening address **(Lord) Rutherford** referred to the preparation, properties, and possible structure of H^2, and the use of H^2 nuclei as swift particles for studying the transformation of elements. Nomenclature was discussed, and the names diplogen for the H^2 atom, and diplon for the nucleus were advocated. **N. V. Sidgwick** dealt with chemical properties, thermochemistry, rates of reaction, and probable influence on chemical knowledge and investigation. **F. W. Aston** indicated the smallness of the mass-ratio differences which led to the search for H^2. **P. Harteck** demonstrated the differences in vapour pressure of normal and heavy water, and in the melting points of normal and heavy ice, and discussed the preparation of heavy water. **F. Soddy** discussed the meaning of the term "isotope." **M. Polanyi** dealt with rate of ionisation in connection with over-voltage and catalysis, **E. K. Rideal** with the work of Farkas on ortho-para-hydrogen conversion, **R. H. Fowler** with the mechanism of separation of electrolysis, **R. P. Bell** with the effect of different factors on the electrolytic fractionation, **J. D. Bernal** with crystal dimensions of heavy ice, and **W. Jevons** with spectroscopic data. N. M. B.

1384. Isotopic Analysis of Water by Interferometer. R. H. Crist, G. M. Murphy and H. C. Urey. *J. Chem. Phys.* 2. *pp.* 112–115, *March*, 1934.—A method of analysis of mixtures of H^1 and H^2 oxides is presented. It consists in calibrating the apparent difference in indices of refraction of natural water and that containing higher concentrations of H^2 oxide, as obtained by a Zeiss water interferometer, against the corresponding differences in specific gravities. It is found that these two quantities are not proportional. The precision of measurement in the neighbourhood of an experimentally determined specific gravity in a 40·06 mm. cell is 0·01 per cent. AUTHORS.

1385. Isotopic Ratio in Oxygen. W. R. Smythe. *Phys. Rev.* 45. *pp.* 299–303, *March* 1, 1934.—A new mass-spectrometer has been constructed along lines previously described [see Abstract 3940 (1932)] in which the defects that appeared in the first apparatus are eliminated. The electrostatic analyser has been slightly altered to take full advantage of its focussing properties for which a formula is given. Because of the faintness of the scattered background, very weak peaks can be measured precisely. Oxygen, prepared by the decomposition of PbO_2, has been analysed and the ratio of the amount of O^{16} to O^{18} found to be 503 ± 10. It is suggested that the discrepancy between this and previous values may be due to the method of preparation of the oxygen sample. AUTHOR.

1386. Neutrons. L. Meitner and K. Philipp. *Zeits. f. Physik,* 87. 7–8. *pp.* 484–497, *Jan.* 26, 1934.—Measurements in the Wilson chamber of length and collision angle were carried out on proton rays liberated by Be-neutrons. The collison neutron-proton seems to be spherically symmetrical in the centre of gravity system. The neutron energies deduced from the measurements show a maximum value of 13 to 14 $\times 10^6$ volts. The preponderating occurrence of proton paths which are associated with neutron energies between $0\cdot19$ and $1\cdot9 \times 10^6$ volts can be attributed, at any rate, partly, to the dependence of the effective cross-section on the neutron velocity. Similar measurements were made for the collision neutron-nitrogen nucleus. For some disintegrations of N^{14} and O^{16} by Be-neutrons the energy balances are given and some consequences for the state of excitation of the newly arising nuclei (B^{11} and C^{13}) are discussed. From the measurements values for the mass of the neutron are deduced and discussed. J. J. S.

1387. Equations of Motion of the Neutron. W. M. Elsasser. *Comptes Rendus,* 198. *pp.* 441–443, *Jan.* 29, 1934.—It is shown how the relativistic hamiltonian for the motion of a particle which has zero charge but possesses a magnetic moment, can be constructed. This leads to Schrödinger's equation for the neutron and thence to the equations of motion. The type of motion is described and in particular it is shown that the motion of the spin consists essentially of a precession around the direction of the magnetic field. G. C. McV.

1388. Elementary Inexactitude of Measurement in Atomic Physics, Limits of the Periodic System and Mass-Relation of Electron and Proton. W. Glaser and K. Sitte. *Zeits. f. Physik,* 87. 9–10. *pp.* 674–686, *Feb.* 3, 1934.—For the possible number of chemical elements, Sommerfeld deduced (1924) from the fine-structure formula a maximum of either 137 or 68: Gordon showed (1928) that the Dirac theory led to Z less than 118. The authors now find that the principle of elementary inexactitudes leads to the exact maximum 92. Assuming that the neutron may be regarded as a quantum-mechanical system built up of proton and electron, this principle leads to a numerical value of $1834\cdot4 : 1$ for the mass-relation between proton and electron. The relation between Schrödinger's trembler-motion and this principle is discussed. A.D.

1389. Internuclear Distances and Bond Force Constants. R. M. Badger. *J. Chem. Phys.* 2. *pp.* 128–131, *March,* 1934.—It has been found that for diatomic molecules the relation between the bond force constant, k_0, and the internuclear distance, r_e, is quite accurately given by the expression $k_0(r_e - d_{ij})^3 = 1\cdot86 \times 10^5$, where d_{ij} is a constant depending only on the rows in the periodic table in which the two elements comprising the molecule are located. The expression holds not only for the normal state but for all excited states with a few possible exceptions. Some uses of the relation are discussed and an extension to polyatomic molecules is suggested. AUTHOR.

1390. Structure of Organic Compounds of High Molecular Weight. H. Staudinger. *Naturwiss.* 22. *pp.* 65–71, *Feb.* 2, *and pp.* 84–89, *Feb.* 9, 1934.—This very comprehensive discussion of the above problem deals with (1) stability and molecular form of organic compounds; (2) structure of the highly polymerised products; (3) importance of the synthetic polymerides for constitutional investigation of natural substances of high molecular weight; (4) viscosity laws; (5) nature of colloidal solutions of substances of high molecular weight; (6) heteropolar molecular colloids; (7) a final section devoted to the new outlook which recent work has brought to bear upon the elucidation of natural processes and natural products. H. H. Ho.

1391. Structure of Ethylene. W. G. Penney. *Roy. Soc., Proc.* 144. *pp.* 166–187, *March* 1, 1934.—Calculations have been made to determine the structure of the ethylene molecule. Two modes of attack are employed, that of electron pairs and that of molecular orbitals. The two methods give consistent results. It is shown that the most stable arrangement has all six nuclei coplanar, with a large HCH angle, perhaps about 130°. The energy needed to rotate one of the CH_2 groups through $\pi/2$ about the C-C axis is quite small, probably about $\frac{1}{2}$ volt. Similar calculations on the ethane molecule show that it is only the H-H repulsions that prevent the free rotation of the CH_3 groups about the C-C axis. AUTHOR.

1392. Shapes of Molecules. N. V. Sidgwick. *Roy. Inst., Proc.* 28. *pp.* 35–45, 1933–1934.—A brief popular exposition of contemporary views on molecular magnitudes and structure. N. M. B.

See also Abstracts 1398, 1485, 1542, 1546, 1560, 1593, 1614, 1621, 1632, 1645.

COLLOIDS.

1393. New Theory of Ferric Oxide Hydrosols. W. F. Fair, Jr. *J. Phys. Chem*, 38. *pp.* 19–34, *Jan.*, 1934.—The law of mass action applied to the hydrolysis of ferric salts is used to give an explanation of the stability of ferric oxide hydrosols. A. S. C. L.

1394. Electrokinetic Potential of Thin Metal Films. G. W. Smith and L. H. Reyerson. *J. Phys. Chem.* 38. *pp.* 133–151, *Feb.*, 1934.—A streaming potential method for the determination of the electrokinetic potentials of metals in contact with their ions has been developed, and measurements were made on the systems silver-silver ion and nickel-nickel ion, as well as on pure silica gel. Metallised silica gels were used in the investigation. They were prepared by the new process of adsorbing complex ions of ammonia on the silica gel and later reducing to the metallic state. A valve potentiometer and a valve conductivity bridge have been adapted to this type of work with excellent results. Fundamental differences between the electrokinetic potentials and the Nernst potentials were found for the systems studied. AUTHORS.

1395. Cryotropic Behaviour of Inorganic Jellies. S. Prakash. *Indian Journ. Phys.* 8. *pp.* 231–242, *Dec.* 15, 1933.—Some of the jellies show a new sort of sol-gel transformation, which has been termed cryotropy. Jellies like ferric phosphate and arsenate, aluminium and zirconium hydroxides and thorium molybdate and phosphate give rise to a sol when frozen in liquid air and again brought to the initial temperature. This sol is again converted to a gel on further standing. The process can be indefinitely repeated even with aged jellies. The jellies which have developed marked agglomeration tendency are non-cryotropic. The conditions favouring cryotropy and its relation with thixotropy are discussed. AUTHOR.

1396. Liesegang Gas Bubbles. D. L. Talmud. *Phys. Zeits. d. Sowjetunion,* 4. 5–6. *pp.* 861–863, 1933. *In German.*—In a series of papers Hatschek has investigated the formation of gas bubbles in gels. When a gelatin gel is mixed with a solution containing carbonate and is brought into contact with a dilute acid solution, the bubbles of CO_2 which form in the gel are not spherical but lens shaped. Talmud disagrees with Hatschek's explanation that the gas bursts through the gel which behaves as a solid rather than as a liquid. It is advanced that the true cause of the lens shape is analogous to that of the formation of Liesegang rings, and depends on the direction of diffusion of the acid in the gel. When the surface of separation of the gel and acid is a plane the bubbles are flat. When the surface of separation is concave upwards the bubbles are also concave upwards. P. H. B.

1397. Structure of Thin Layers of Rubber. S. E. Bresler, E. A. Strauff and I. L. Zelmanoff. *Phys. Zeits. d. Sowjetunion,* 4. 5–6. *pp.* 885–888, 1933. *In German.*—The rubber membranes examined were obtained from a solution of white crêpe rubber in benzene. In most cases they possess crystalline structure and exhibit sharp interference rings consisting of separate spaced points, which indicate comparatively large crystals. Frequently the membrane melts through the action of the electron pencil and becomes amorphous. Although the crystallised membranes give a Debye-Scherrer diagram consisting of regular intense circles, they all possess a certain orientation. It is known that the chains of cellulose esters in the monomicellar layers are arranged parallel to the surface of the water, and it may be assumed that the rubber crystallites, which are extended in the direction of the principal valencies, are similarly arranged in the membranes. T. H. P.

1398. X-Ray Studies of the Structure of Hair, Wool and Related Fibres. Part II. Molecular Structure and Elastic Properties of Hair Keratin. W. T. Astbury and H. J. Woods. *Roy. Soc., Phil. Trans.* 232. *pp.* 333–394, *Dec.* 20, 1933.—A record of the results of wide examination of X-ray photographs of mammalian hairs, etc., in order to determine their structure in relation to their elastic properties. The X-ray photograph of stretched hair (β keratin) is analogous to that of natural silk whether stretched or unstretched. Stretched hair is therefore built up of extended polypeptide chains while unstretched hair consists of the same chains in a folded state, signifying the existence of a reversible elastic molecular mechanism for this transformation. The molecular complex of the α keratin stretches reversibly by about 2 % before the onset of the main transformation. The limiting extensibility of all mammalian hairs is about 100 % of the initial length. The authors assign to α keratin the form of intramolecular folds of the nature of pseudo-diketopiperazine rings which open up on extension to produce the normal zigzag protein chain. These folds are transverse to the general direction of the side-chains. In β keratin the side-chains are roughly coplanar and unite adjoining main chains by cross linkages, including covalent and electrovalent bonds. The β keratin structure is one of flat polypeptide grids. From chemical analyses of keratin, figures are quoted in close agreement with the conception of an average volume per amino-acid residue of 3·38 × 4·65 × 9·8 Å. These quantities may be utilised for determinations of average density of proteins and thickness of monomolecular protein films. The elastic properties of hair are referred to three main phases of the keratin theme, which are associated with intercellular keratin, cell-wall keratin and intracellular keratin. By progressive action on keratin under stress of water at increasing temperatures, or by action of dilute alkali, the special side-chain differences between the three phases are entirely eliminated. Water adsorbed by keratin fibres penetrates not only between chain bundles but also into their interior, and, during hydrolytic modification of keratin by steam or dilute alkalies, spacing disturbances occur in the direction of the side-chains. The phenomena of temporary and permanent set are explained as arising from the redistribution of side-chain linkages, chiefly those of an electrovalent character. The investigation leads to the discovery of a labile stage intermediate between the stages of side-chain rupture and recombination. This labile stage is characterised by enhanced powers of contraction to as much as 45 % of the normal unstretched length. This phenomenon is discussed in detail. The elastic recovery of β keratin to α keratin is a function of its degree of hydration, complicated by the side-chain redistribution. The adsorption of water by hair appears to have features of a permutoid reaction. Irradiation with ultra-violet light or X-rays causes intromolecular changes analogous to those caused by water on stretched keratin, with the result that supercontraction and set are accelerated. Unstretched hairs after prolonged irradiation with X-rays contract spontaneously in steam. The reaction of water, etc. with stretched keratin or irradiation of unstretched keratin by X-rays causes increased longitudinal swelling. [For Part I see Abstract 3107 (1931).] S. G. B.

1399. Heavy Elastica. W. G. Bickley. *Phil. Mag.* 17. *pp.* 603–622, *March,* 1934.—The primary object of the paper is to provide numerical data of an accuracy greater than that of experimental results for use in reducing the observations made in certain tests of the physical properties of cotton fabrics. The cases considered fall into two classes, the "cantilever" and the "heart loop," which are in use for ordinary and very flimsy materials respectively, and the main point of the treatise is the set of tables and graphs of the results obtained. The general differential equation is derived for the shape of a uniform strip of elastic material due to its weight and certain definite methods of support. It is assumed throughout that curvature is proportional to bending moment. In the Pierce cantilever method one end of a strip of material is clamped horizontally and the strip is allowed to sag under its own weight. The angle between the chord and the horizontal is measured, and the bending length is deduced from and the length of the strip. The present work suggests accurate numerical results to replace the use of the empirical formula usually employed. These are presented in a series of tables and graphs. The heart loop method is used for testing more flimsy materials for which the cantilever is unsuitable since such materials fall nearly vertically. The two ends of the strip are clamped together vertically and the material allowed to fall in the shape of a heart loop. There is now no free end at which all conditions are known *a priori*. From the ratio of the sag to the length of the side arc the bending length is calculated. Again tables and graphs are given and the results used to explain and extend the values found experimentally by Pierce. S. G. B.

1400. Gelatinised Emulsions. S. Bresler, M. Katz and L. Kremnef. *Phys. Zeits. d. Sowjetunion,* 4. 5–6. *pp.* 889–893, 1933. *In German.*—The method for the production of gelatinised emulsions is described. Emulsions of volatile organic liquids, such as ether, chloroform, CCl_4, were prepared. Saponin and gelatin, as well as the more usual emulsifying agents, sodium and potassium oleate, were employed. The swelling pressure of gelatinised and inverted emulsions was measured. F. J. B.

1401. Rate of Sedimentation of Suspensions of Kaolin. A. Boutaric and Madeleine Roy. *Phys. Zeits. d. Sowjetunion.* 5. 1. *pp.* 131–145, 1934. *In French.*—Experiments on the rate of sedimentation of suspensions of kaolin are carried out in vertical tubes 1 metre long, the observed quantity being the rate of descent of the surface of demarcation between the suspension and the clear supernatant liquid. This rate is found to vary with time according to a hyperbolic law, for which a theoretical interpretation is suggested. The rate decreases with increase of the concentration or age of the suspension. It is very susceptible to small changes in the acidity of the liquid, being accelerated by acids and retarded or suppressed by alkalies. An investigation is made upon the effect of adding salts or substances which produce large changes of surface tension, the effect of small alterations of acidity being eliminated by using $N/1000$ sulphuric acid instead of water. Contrary to the reports of certain other workers, the added substances are found not to affect the rate of sedimentation. L. A. W.

1402. Rapid Electro-Dialyser. H. Brintzinger, A. Rothhaar and H. G. Beier. *Kolloid Zeits.* 66. *pp.* 183–188, *Feb.,* 1934.—An electro-dialyser for rapid dialysis is described and compared with dialysers of different design. The membrane carried can be rotated, and fitted with different membranes as desired. The membranes investigated were parchment paper, cellophane, silk, treated with chromgelatin and exposed to light. The most favourable conditions for the maximum efficiency of the rapid electro-dialyser were determined, and its dependence upon the selection of the most suitable membrane and a suitable temperature. F. J. B.

1403. Mechanical Properties of Disperse Systems. Part II. Deformation of Soils under Tension. G. I. Pokrowski and W. G. Bulytschew. *Kolloid Zeits.* 66. *pp.* 137–139, *Feb.,* 1934.—With disperse systems of high concentration, it is shown that the relation between force and deformation may be represented by a single mathematical expression for both compression and tension. Moreover, in the transition from tension to compression, and *vice versa,* no sudden change occurs in the modulus of elasticity. Experiments with soils (clays) give results which, in general, confirm these conclusions. [For Part I see Abstract 4311 (1933)]. T. H. P.

See also Abstracts 1377, 1378, 1390, 1525, 1708, 1717.

CRYSTAL STRUCTURE AND PROPERTIES.

1404. Structure of Metallic Layers. M. I. Gen, I. Zelmanoff and A. I. Schalnikoff. *Phys. Zeits. d. Sowjetunion,* 4. 5–6. *pp.* 825–834, 1933. *In German.*—The structure of thin metallic layers deposited from the vapour on surfaces cooled down to −183° C. is determined by means of electronic diffraction. The metals considered are Ni, Fe, Cd and Hg. It is found without exception that the crystal structure is the same as that found for these metals in their normal state. The photographs are characterised, however, by a high degree of dispersion. When the vapours are more quickly condensed the degree of dispersion grows less, and in the case of cadmium a definite preferential orientation is observed. On heating the deposited metals up to room-temperature, recrystallisation takes place, the crystal grains growing in size. The significance of the results is discussed in relation to existing theories of the mechanism of condensation. J. T.

1405. Surface Lattice Interference with Electron Rays Passing Through Thin Metal Foils. H. Lassen. *Phys. Zeits.* 35. *pp.* 172–175, *Feb.* 15, 1934.—Thin silver foils, varying from pale to deep blue by transmitted light, were prepared by vaporising silver *in vacuo* and condensing it on a plane surface of rock-salt. The films were subsequently removed by water, mounted on a perforated bronze block, inserted in an electron-ray tube and submitted to bombardment by electrons with energies from 30 kV to 35 kV. In some cases only the usual Debye-Scherrer diffraction rings were observed, but in others point interference patterns were obtained. The patterns agreed well with those to be expected theoretically from surface lattice interference, if the cubical surface of single silver crystals was orientated parallel to the surface of the foil. Photographs of several of the interference patterns are reproduced. F. C. C.

1406. Structure and Gas Content of Nickel Sheets Produced by Kathodic Pulverisation. W. Büssem and F. Gross. *Zeits. f. Physik*, 87. 11–12. *pp.* 778–799, *Feb.* 19, 1934.—The structure of nickel sheets is hexagonal I if they are produced by kathodic pulverisation in hydrogen; but tetragonal and hexagonal II if nitrogen is used as surrounding gas. The hexagonal I phase can be converted into the cubic form, the tetragonal phase into the hexagonal II phase and this agian into the cubic. It depends on the purity of the gas and on the temperature during the pulverisation whether one or the other phase arises. All sheets contain hydrogen. [See Abstract 34 (1934)]. J. J. S.

1407. Structure of Cold-Worked Silver Chlorides and their Recrystallisation. V. Caglioti. *Accad. Lincei, Atti*, 18. *pp.* 570–574, *Dec.* 17, 1933.—A summary is given of the results of a study of the structure of wires of AgCl prepared from the salt after fusion, and of their recrystallisation and of the variations of hardness caused by their mechanical deformation. The wires and also laminæ are transparent, the thinnest wires prepared being 0·2 mm. in diameter. The wires exhibit a fibrous structure which is not very highly developed. The crystallites are orientated mostly according to the axis [100] but partly according to [111]. The temperature at which the original hardness is recovered falls as the extent to which the laminæ are worked increases. T. H. P.

1408. Fibrous Structure in Ionic Lattices. G. R. Levi and M. Tabet. *Accad. Lincei, Atti*, 18. *pp.* 574–579, *Dec.* 17, 1933.—Examination of AgCl and AgBr drawn into wire at high pressures (3400–3500 atmospheres) reveals a distinct fibrous structure. AgCl is orientated completely according to the fibre axis 111 and AgBr according to 100. The inclination of the axis of orientation to that of the wire-drawing is marked in the outermost parts of the wire, but vanishes in the interior. Breaking tests of the various preparations show that the effect of recrystallisation is of the same type as for metals and that orientation has a somewhat greater influence. This is the first proved case of fibrous structure in ionic lattices. With TlCl, TlBr, and AgI, no fibrous structure could be detected, owing to the appearance of polymorphous forms. T. H. P.

1409. Lattice Constant of Carbon Dioxide. W. H. Keesom and J. W. L. Köhler. *K. Onnes Lab., Leiden, Comm. No.* 230*b*. 1933. *Physica*, 1. *pp.* 167–174, *Jan.*, 1934. *In English.*—The crystal structure of carbon dioxide was investigated. A cubic structure, space group $T^6{}_h$, was confirmed. The lattice constant was found to be 5·575 ± 0·005 Å at − 190° C. The distance $C - O$ is 1·13 ± 0·02 Å. AUTHORS.

1410. Structure of Ferric Oxychloride. S. Goldsztaub. *Comptes Rendus*, 198. *pp.* 667–669, *Feb.* 12, 1934.—Ferric oxychloride, FeOCl, is orthorhombic with *a* 3·75, *b* 7·95, *c* 3·4 Å, with 2 molecules in the unit cell, space group $V_h{}^{13}$—*mnm*. The structure consists of layers, each made up of two subordinate layers of Cl atoms, with two others, each of alternate Fe and O atoms, between them. Cl–Cl in the same principal layer is 3·3, in different layers 3·75 Å. The perfect cleavage parallel to (010) is thus explained. C. A. S.

1411. Structure and Formula of 12-Phosphotungstic Acid. J. F. Keggin. *Roy. Soc., Proc.* 144. *pp.* 75–100, *March* 1, 1934.—The structure of the molecule of this acid, which has the formula $H_3[P(W_3O_{10})_4]$ nH_2O, has been determined by the powder method. The anion consists of a central PO_4 tetrahedral group surrounded by 12 WO_6 octahedral groups as a shell, linked together by shared oxygen atoms. The symmetry is T_d. In the partially dehydrated acid examined, containing 5 molecules of water per molecule of acid, the acidic anions pack together with cubic symmetry, the edge of the unit cube being 12·14 ± 0·005 Å; the symmetry is O_h^4 and the unit cube contains two molecules of the acid. These results are in agreement with the bulk of the chemical evidence.

T. H. P.

1412. Structure of the Trithionate Group, $(S_3O_6)^{-2}$. W. H. Zachariasen. *J. Chem. Phys.* 2. *pp.* 109–111, *March*, 1934.—The structure of the trithionate group is found from a complete determination of the crystal lattice of the potassium compound. Two of the S atoms form four bonds each, three bonds with O atoms and one with S. The four bonds are directed towards the corners of a tetrahedron. The third S atom forms only two bonds, both with S atoms; the bond angle is 103°. The S − O distance is 1·50 Å and the S − S distance 2·15 Å. Some features of the binding in sulphur-oxygen radicals are briefly discussed. AUTHOR.

1413. Structure of High-Temperature Forms of Silver- and Cuprous-Mercuric Iodides. J. A. A. Ketelaar. *Zeits. f. Krist.* 87. *pp.* 436–445, *April*, 1934.— The red α-Ag_2HgI_4 and chocolate-brown α-Cu_2HgI_4, stable respectively above 50° and 70°, are cubic with *a* 6·383 and 6·103 Å, and one molecule in the unit cell, space groups $T^2{}_d$ and T^2. The 4I occupy a face-centred cubic lattice, with co-ordinates 1/4 1/4 1/4, 1/4 3/4 3/4, 3/4 1/4 3/4, 3/4 3/4 1/4; the 2Ag (or Cu) and Hg form an "averaged structure" occupying in random fashion three-fourths of another face-centred cubic lattice, *i.e.*, of the positions 000, 0 1/2 1/2, 1/2 0 1/2, 1/2 1/2 0. The transition from the pseudocubic tetragonal structure of the low temperature α-modification is due to gradual change with heat of the relative lattice energy, and exemplifies Smit's allotropy theory. Revised values for the β-form of Cu_2HgI_4 are *a* 6·041, *c* 6·115. [See Abstract 1099 (1932).] C. A. S.

1414. Crystal Hydrates. Part II. Structure of Chromic and Aluminium Chloride Hexahydrates. K. R. Andress and C. Carpenter. *Zeits. f. Krist.* 87. *pp.* 446–463, *April*, 1934.—$Cr(H_2O)_6Cl_3$ and $Al(H_2O)_6Cl_3$ are rhombohedral, with respectively a $7\cdot9_8$ and $7\cdot8_5$ Å, α 97° ± 20′, and 2 mols. in the unit cell, space group D^6_{3d}. The $6H_2O$ are arranged octahedrally around the metal ion ($Cr - H_2O = 1\cdot9$, $Al - H_2O = 1\cdot87$ Å), 12Cl are arranged around each $Me(H_2O)_6$ octahedron, equi-distant from its angular points but 4·3 and 4·5 Å from the metal ion. Each H_2O is in contact with 2Cl ($Cl - H_2O = 3\cdot1$ Å), and each Cl is linked with $3H_2O$. The greater polarising power of Cr^{III} causes the distance $Me - H_2O$ to be approximately the same in both salts, though the radius of Cr^{III} (0·62) is > that of Al^{III} (0·57), through H_2O being more compressed by Cr (radius of H_2O 1·28 in the Cr, and 1·30 Å in the Al salt). [For Part I see Abstract 914 (1934).] C. A. S.

1415. Anisotropic Liquids (Liquid Crystals) in Electric Fields. Part III. W. Kast and P. J. Bouma. *Zeits. f. Physik*, 87. 11–12. *pp.* 753–762, *Feb.* 19, 1934.—Experiments upon the dielectric loss and critical frequency in mesomorphic para-azoxyanisol. Maximal losses were encountered which gave a very great temperature gradient, which involves difficulties with Debye's frictional dispersion theory. In the solid range, for the same frequencies, maximal positions of loss are also found. [For Part II see Abstract 3572 (1932).] F. I. G. R.

1416. Light Transmission of the Anisotropic Melt of Para-azoxyanisol in a Magnetic Field. W. Kast and L. S. Ornstein. *Zeits. f. Physik*, 87. 11–12. *pp.* 763–767, *Feb.* 19, 1934.—The disturbance of the constraints when a magnetic field is shut off is discussed for para-azoxyanisol. The light-transmission immediately the field is removed is considered to decide in favour of the "swarm-theory" rather than the "continuous-theory." [See also Abstract 4335 (1933).] F. I. G. R.

1417. Modification of Crystal Faces in a Solution Containing Foreign Substances. L. Royer. *Comptes Rendus*, 198. *pp.* 585–587, *Feb.* 5, 1934.—The considerations previously advanced [see Abstract 921 (1934)] are illustrated by the effect of dissolved $CdCl_2$ on NaCl crystals and that of dissolved $NaNO_3$ on crystals of NH_4I, KI and KBr. T. H. P.

1418. Relation between Plastic Shortening and Pressure for Salts and Metals. K. Przibram. *Akad. Wiss. Wien, Ber.* 142. 2a. 8. *pp.* 377–380, 1933.—The formula previously given for the dependence of shortening on the pressure [see Abstract 3550 (1932)] may be expressed in the simpler form $s^1 = b\sigma p$, where $s^1 = (h_0 - h)/h$ gives the shortening in relation to the height of the specimen after pressing, σ is the degree of thinness, and p the pressure [see Abstract 5141 (1933)]. Taken as a whole, the experimental results are in agreement with this expression, although marked individual deviations, due to various causes, are observed. The general conclusion drawn is as follows: on pressure between polished steel surfaces, there is an extended region of p and σ within which, for both alkali halide crystals and ordinary copper and lead, the shortening referred to the final height of the specimen is, on the average, proportional to the product σp. For the various series of alkali halides, the proportionality (plasticity) coefficient b varies systematically with the lattice constants or with the order number of the components. T. H. P.

1419. Elastic Behaviour and Elastic Constants of Zinc Single Crystals. A. W. Hanson. *Phys. Rev.* 45. *pp.* 324–331, *March* 1, 1934.

—The elastic constants are determined from bending and torsion experiments on single crystal rods. It is shown that for each crystal orientation there is a definitely limited region of proportionality between an initially increasing stress and the corresponding strain. The elastic region is a minimum (and very small) for crystals of 45° orientation. Elastic hysteresis occurs for bending but not for torsion, except for previously permanently strained crystals. There is no permanent set for stresses within the elastic limit. Two slightly different grades of very pure (99·99 + per cent) zinc are studied. Their elastic behaviour is in general alike, but the elastic constants differ appreciably. The constants found are: for Evanwall zinc, $S_{11} = 8\cdot08$; $S_{12} = 1\cdot57$; $S_{13} = -7\cdot85$; $S_{33} = 26\cdot28$; $S_{44} = 25\cdot15$; for Horsehead Special zinc, $S_{11} = 7\cdot70$; $S_{12} = 0\cdot45$; $S_{13} = -6\cdot39$; $S_{33} = 27\cdot66$; $S_{44} = 24\cdot40$, all times 10^{-13} cm^2/dyne. The single crystal form possesses a definite and reproducible elastic behaviour in contrast with the puzzling and variable results obtained for the polycrystalline and technically usable material. AUTHORS.

1420. Debye-Scherrer Photographs. G. Greenwood. *Indian Journ. Phys.* 8. *pp.* 269–273, *Dec.* 15, 1933.—Using the method of extrapolation to $\theta = 90°$, the author determines the lattice constant of cadmium oxide. This is found to be 4·682 Å in good agreement with values previously obtained by other workers. J. T.

1421. Schubnikow Universal Stage. G. B. Boky. *Zeits. f. Krist.* 87. *pp.* 425–435, *April,* 1934.—This arrangement is a simplified apparatus, based essentially upon the Federow plan. A glass hemisphere forms the orientating device, and the inclination is increased to 140°, compared with a maximum of 120° with the Federow. There is no need to employ a specially large microscope. F. I. G. R.

1422. Self-Registering Pendulum Sclerometer. A. Schubnikow. *Zeits. f. Krist.* 87. *pp.* 499–502, *April,* 1934.—The particular improvement over previous instruments of this kind (which measure hardness by allowing an oscillating point to graze the surface of the specimen) is the introduction of a convergent lens to make a record of the motion upon a suitably placed photographic plate. Examples are given of its use on rock-salt. F. I. G. R.

See also Abstracts 1429, 1473, 1552, 1571, 1620, 1631, 1654, 1655, 1661, 1707, 1709, 1731.

DIFFUSION AND OSMOSIS.

1423. Optical Osmometer. C. H. Dwight and H. Kersten. *Rev. Sci. Instruments,* 5. *pp.* 130–131, *March,* 1934.—An osmometer is described which makes use of an optical lever for measuring rapid changes in volume of a solution in osmosis. It can be read at a distance and gives magnified readings. AUTHORS.

See also Abstracts 1711, 1759.

ELASTICITY AND PLASTICITY.

1424. Finite Deformations of Systems with Reversible Transformations. A. Signorini. *Accad. Lincei, Atti,* 18. *pp.* 388–394, *Nov.* 5, 1933.—When the characteristic function for systems with reversible transformations is known, the three principal stresses are shown to be locally specified by the strain and the temperature. For this purpose a secular equation of the third order is assigned, which in the case of istropic systems (that is, when the characteristic function depends on the strain only through the three principal invariants of deformation) reduces to three equations of the first degree. It is also shown that the necessary and sufficient condition that such a system be isotropic in the prescribed configuration of reference is that, in every transformation, for each principal trihedral of deformation the image in the actual configuration is a principal trihedral of stress. A. J. McC.

1425. Loaded Plates under Compression. P. Sonier. *Comptes Rendus,* 198. *pp.* 435–437, *Jan.* 29, 1934.—If a thin plate, lying in the xy plane, is subjected to compressions N and N′ per unit length over sections perpendicular to the x and y axes respectively, the resulting deformations are the same as if the load parallel to the z axis were increased by the quantities N/ρ and N'/ρ', where ρ and ρ' are the radii of curvature at a point. This principle is employed to simplify the calculations for clamped and supported rectangular plates, and to the theory of the buckling of the plate. J. P. A.

1426. Extension of Metal Wires under Longitudinal Stress. Part III. L. C. Tyte. *Phil. Mag.* 17. *pp.* 634–651, *March,* 1934.—The stress and total extension have been shown to be connected by an exponential relation even at small loads. The upper limit of the range for which this relation holds has been identified with the yield point. The deviations from proportionality of stress and strain have been attributed to plastic distortion in certain suitably disposed crystals. [For Part II see Abstract 1828 (1932).] AUTHOR.

1427. Compressibility of Aqueous Solutions. Edith H. Lanman and B. J. Mair. *Am. Chem. Soc., J.* 56. *pp.* 390–393, *Feb.,* 1934.—Data for the compressibility coefficients of aqueous solutions of LiCl, NaCl, KCl, LiOH, NaOH, KOH, HCl, HAc and KAc, each at three concentrations, and of glacial acetic acid are given. All measurements were made at 25°, and between 100 and 300 megabars. The linear relationship pointed out by Gucker [see Abstract 4347 (1933)], between the apparent molal compressibility and the square root of the concentration, is confirmed. N. M. B.

1428. Softening of Vitreous Bodies. E. Rencker. *Comptes Rendus,* 198. *pp.* 571–573, *Feb.* 5, 1934.—A method of measuring plasticity is described in which the speed of penetration of a needle into the substance under test is determined. Measurements have been made and curves are given for vitreous selenium, boric anhydride and two organic glasses. The curves show the variation of plasticity with temperature. [See also Abstract 5366 (1933).] W. D. W.

1429. Flattening of Polycrystalline Metals near the Melting Point. W. D. Kusnetzow and N. A. Bolschanina. *Phys. Zeits. d. Sowjetunion,* 5. 1. *pp.* 31–39, 1934. *In German.*—A Brinell method is used in which the impression of small steel spheres (diameter 2·5 mm.) on polycrystalline metals is measured at temperatures near the melting point for Sn, Bi, Cd and Zn. The samples are in cylindrical form and the method used is fully described. The results are illustrated by diagrams. It is evident that the greatest change in the diameter of the impression occurs within a few degrees of the melting point and approaches more nearly to that of the steel sphere, and especially so for Sn and Zn. It is thus shown that the atomic or molecular cohesion of the crystals weakens and approximates to zero at the melting point. [See Abstract 486 (1930).] R. S. R.

1430. Photoelastic Apparatus. J. H. A. Brahtz. *Rev. Sci. Instruments,* 5. *pp.* 80–83, *Feb.,* 1934.—A description is given of the reflector polariscope built at the California Institute of Technology. The preparation of models and the technique is explained. Examples of systems of isochromatics and isoclinic lines obtained in models of the Pine Canyon Dam, California, are reproduced. AUTHOR.

1431. Optical Arrangement for Photoelastic Measurements. A. Goetz. *Rev. Sci. Instruments*, 5. *p.* 84, *Feb.*, 1934.—A modification of the usual apparatus for photoelastic measurements is described in which the large convex lenses on both sides of the specimen are replaced by concave mirrors. The advantages lie in the absence of chromatic aberrations (isochromatic method) and inhomogeneities due to local anisotropies in the lenses ; furthermore the price of the apparatus is cut to a fraction. The aberrations of the mirrors—astigmatism and coma—can be made negligible by the symmetrical arrangement of the optical paths and by proper choice of the optical ratio. AUTHOR.

1432. Micromanometer. O. Stålhane. *Journ. Sci. Instruments*, 11. *pp.* 79–82, *March*, 1934.—This paper briefly describes the principles governing the design of a new micromanometer. The most important point is that the great mobility of and absence of " lag " in the ordinary spirit-level air bubble have been utilised for the zero adjustment. The two communicating vessels are moreover arranged so that they can be connected by a rigid pipe, thus avoiding rubber tubing and its attendant drawbacks. The instrument can be rapidly and conveniently read, and it is accurate to 0·01 mm. of water. AUTHOR.

See also Abstracts 1398, 1418, 1438, 1633, 1659, 1661, 1747.

GRAVITATION.

See Abstract 1517.

HYDRODYNAMICS AND AERODYNAMICS.

1433. Vibration of a Metallic Rod in Liquid Subjected to Transitory Motion. E. Crausse. *Comptes Rendus*, 198. *pp.* 437–439, *Jan.* 29, 1934.—It is shown experimentally that it is possible, in certain cases, to avoid causing vibration of a long rod supported vertically in a stream of water by varying the velocity of the stream sufficiently rapidly. J. S. G. T.

1434. Waves Excited by a Plate Oscillating on the Surface of a Liquid. A. Dimpker. *Ann. d. Physik*, 19. 3. *pp.* 225–251, *Feb.*, 1934.—A theoretical and experimental investigation of the waves excited by an oscillating plate in contact with the surface of a liquid is described. The results obtained are in agreement with those obtained by a different method by Cauchy and Poisson. J. E. R. C.

1435. Transient Régimes in the Motion of Liquids, and the Establishment of Turbulent Flow. J. Baubiac. *Comptes Rendus*, 198. *pp.* 148–151, *Jan.* 8, 1934.—Study of the variation of the rate of flow of liquid in tubes of 2 to 5 cm. dia., at various Reynolds numbers, shows that there is a transient régime bordering upon the turbulent régime which is analogous to that found previously [see Abstract 1862 (1933)] in connection with the establishment of the Poiseuille régime. For homologous points of the tubes used there is a critical value of the Reynolds number above which turbulent flow commences after the expiration of a well-defined period ; the period is the shorter, the greater is the Reynolds number. H. F. G.

1436. Irregularities in the Rotatory Movement of a Viscous Fluid. J. Avanessoff. *Comptes Rendus,* 198. *pp.* 537–539, *Feb.* 5, 1934.—Purely mathematical. H. F. G.

1437. Wave-Profiles and Wave-Resistances. W. C. S. Wigley. *Roy. Soc., Proc.* 144. *pp.* 144–158, *March* 1, 1934.—The several effects of the various geometrical features of a body on the form of the waves it generates when moving on the surface of water, and on the resistance it experiences, are of theoretical as well as practical interest to shipbuilders. It is now possible to investigate this influence, for simple forms, by approximate methods of calculation; in this paper an investigation is described for a form having parabolic waterlines; where possible the results of calculation are compared with actual measurements made in the Alfred Yarrow tank at the William Froude Laboratory. It is found that there is a general agreement between measurement and calculation. The main difference between the parabolic forms dealt with here and straight line forms previously investigated is that the ends of the former contribute more largely to the wave resistance. No conclusions can be drawn concerning the wave making effects with other shapes until further experiments and calculations have been made. AUTHOR.

1438. Analogy between the Slow Motions of a Viscous Fluid in Two Dimensions and Systems of Plane Stress. J. N. Goodier. *Phil. Mag.* 17. *pp.* 554–576, *March,* 1934.—An analogy between the two-dimensional, slow, steady motion of an incompressible viscous fluid between rigid boundaries and the transverse flexure of an elastic plate clamped along the same boundaries was discussed by Rayleigh. The problem of an elastic plate strained by forces in its own plane involves the solution of the same biharmonic differential equation. It has been considered that the boundary equations in the fluid and elastic problems are essentially different. This is shown not to be the case. The methods of photoelasticity, developed for the investigation of elastic problems are therefore applicable to the study of fluid motions. Among the problems discussed are, flow through a channel with inclined walls, flow round a cylindrical bend, and an elliptical cylinder rotating in infinite fluid. *Addendum, ibid. pp.* 800–803, *April,* 1934. J. S. G. T.

1439. Determination of the Direction and Velocity of Flow of Fluids. L. S. Marks. *Frank. Inst., J.* 217. *pp.* 201–212, *Feb.,* 1934.—The methods applicable to steady flow and more especially to two dimensional flow are outlined. The author's modification of the Pitot tube consists in placing a short tube, streamlined outside, a little ahead of the Pitot tube; since the bore is greater than that of the Pitot tube, the flow through the latter is not altered. The effect of the short tube when the apparatus is inclined to the direction of flow is such that with a manometer reading to 0·01 in. the device is sensitive to within 2·7° for a head of 1·1 in. and 0·6° for a head of 4·4 in.; the static pressure readings are unchanged. In another, more sensitive instrument, a tube provided with three holes is placed normally to the direction of flow, the two outer holes being connected to a differential manometer and the third to a separate manometer. The differential reading varies about 7 % of the velocity head per degree of rotation of the tube. H. F. G.

1440. Resistance of Impact on Water Surface. Part V. S. Watanabe. *Inst. Phys. and Chem. Research, Sci. Papers, No.* 483. *pp.* 202–208, *Feb.,* 1934. *In English.*—The impact resistance of a sphere falling on water is investigated along experimental lines already developed by the author [see Abstract 947 (1934)]. The resistance (R) is found to be proportional to (1) the height of fall, and (2) the square of the velocity at the water surface, the depth of immersion (x) being taken as constant in each case. All R·x curves for different heights of fall can be represented by a single curve. J. S. G. T.

See also Abstracts 1444, 1520, 1533.

KINETIC THEORY OF MATTER.

1441. Quantised Brownian Movement. M. Satô. *Zeits. f. Physik,* 87. 9–10. *pp.* 669–673, *Feb.* 3, 1934.—Data are obtained for helium and hydrogen. The quantised movement is observable when a single particle moves in strongly quantised gas. [See Abstract 470 (1934)]. A. D.

1442. Brownian Movements in Gases. R. Fürth. *Zeits. f. Physik,* 87. 11–12. *pp.* 810–814, *Feb.* 19, 1934.—Some papers by M. Satô on the Brownian motion in gases are criticised as incorrect. [See Abstract 470 (1934)]. J. J. S.

1443. Brownian Error of the Resonance Radiometer. J. D. Hardy. *Rev. Sci. Instruments,* 5. *pp.* 120–124, *March,* 1934.—Experimental evidence in support of van Lear's theory [see Abstract 1328 (1933)] concerning the Brownian error of the resonance radiometer is given with photographic records showing the character of the baseline unsteadiness. A comparison is offered between critically damped galvanometer systems and the resonance radiometer from an experimental point of view. AUTHOR.

See also Abstract 1461.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 1584.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

1444. Weight and Mass. F. Hoffman. *Zeits. f. techn. Physik,* 15. 2. *pp.* 49–51, 1934.—The pull of the earth on a given quantity of matter Q (mass *m*) depends on the local value of *g*. The indication of a spring balance measures the force *mg* and therefore shews the " local weight " of Q. On the other hand when a lever balance is employed the pull of the earth on Q and on the standard of mass against which it is balanced is the same, and therefore by a lever balance the mass *m* of Q is determined. Confusion has arisen because the term " kilogramme " has been applied both to mass and to local weight. It is proposed that the term "standard-weight " (P_N) be used for the weight of a body under standard gravity (g_N) and that the term " local-weight " (P) be used for the weight of a body under local gravity $(g) \cdot P = mg = P_N(g/g_N)$. By the simple term " weight," local-weight should be understood. The international prototype kilogramme would be the unit of mass. The " pondus," or the standard-weight of the prototype kilogramme, would be the unit of weight. P. H. B.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

1445. Certain Integrals and Expansions Involving Bessel Functions. S. C. Mitra. *Calcutta Math. Soc., Bull.* 25. *pp.* 81–98, *June,* 1933.—The object of the present paper is to evaluate a number of definite integrals and to obtain several expansions involving Bessel functions, with the help of the Heaviside operational calculus, as developed by Carson and subsequent writers. All the results are not claimed to be new, but it is believed that many of them are. AUTHOR.

1446. Graphical Adjustment of Observations. B. Germansky. *Zeits. f. Instrumentenk.* 54. *pp.* 37–45, *Feb.*, 1934.—The method described is intended to be applied to problems which arise in geodesy, physics and astronomy in which a number of points exist in a plane given by $(x_\times, y_\times)$ where $\times = 1, 2 \ldots . N$ and the optimum curve through them is required according to the method of least squares. The geometrical condition may thus be determined. For the given geometrical state the curve may be displaced or rotated until the sum of the squares of the deviations is a minimum. If the sum of all the curves is given by $y = f(x, \phi, a, b)$ where ϕ is the angle of rotation and a and b the components of displacement, then $\Sigma^N_{\times=1}[f(x_\times, \phi, a, b) - y_\times]^2$ must be a minimum. The theory of the method is given and it is applied first to the case of two parameters. It can be extended by successive approximations to the more general case for more than two parameters. Examples are given of its use. R. S. R.

See also Abstracts 1397, 1649.

MECHANICS, CLASSICAL.

1447. Canonical Transformation of Lagrange's Equations in the Many-Body Problem. N. Saltykow. *Comptes Rendus*, 198. *pp.* 444–445, *Jan.* 29, 1934.—The bodies attract each other according to the inverse square law. A transformation of the equations of motion to the canonical form is developed which is free from certain difficulties pointed out by Poincaré. G. C. McV.

1448. General Theorems on Trajectories and Lines of Force. E. Kasner. *Nat. Acad. Sci., Proc.* 20. *pp.* 130–136, *Feb.*, 1934.—If a particle is placed at rest in a field of force, it begins to move along the line of force on which it is situated. On account of its inertia, the particle follows a path somewhat straighter than the line of force. The trajectory and the line of force thus agree as to initial direction, but differ in initial curvature, with the trajectory lying between the common tangent line and the line of force. In the paper the complete theorems and their proofs are set out and relations are established for the curvature of the trajectory and its order of contact for a particle which starts from rest or with an initial velocity. R. S. R.

See also Abstracts 1464, 1486.

MECHANICS, QUANTUM.

1449. Analysis of Non-Commuting Vectors with Application to Quantum Mechanics and Vector Calculus. G. H. Shortley and G. E. Kimball. *Nat. Acad. Sci., Proc.* 20. *pp.* 82–84, *Jan.*, 1934.—A set of formulæ, modified from those of the usual vector analysis, is obtained for the manipulation of certain vectors whose components are linear operators. Results are illustrated in ordinary vector analysis and in quantum mechanics by deriving the commutation rules connecting the position and momentum of an electron with the angular momentum. N. M. B.

1450. Dirac Equations of the Second Order. J. Géhéniau. *Comptes Rendus*, 198. *pp.* 713–716, *Feb.* 19, 1934.—A system of eight

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equations is found to which the system of second-order Dirac equations is shown to be equivalent. N. M. B.

1451. Pauli's Exclusion Principle. M. Hayakawa. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 67–70, *Feb.*, 1934. *In German.*—Pauli's principle of forbidden lines is interpreted in terms of Dirac's equation in the problem of many bodies. J. S. G. T.

1452. New Interpretation of Wave-Mechanics. E. Madelung and S. Flügge. *Zeits. f. Physik*, 87. 7–8. *pp.* 432–441, *Jan.* 26, 1934. —By introducing a fourth space-dimension U, the scalar potential and the magnetic field are introduced into wave-mechanics as mean values with respect to the direction of U. The point-mass is imagined to be held fixed by a constraining force in the space of one perception (x, y, z). Quantum phenomena may be interpreted as motions in the U-direction. In the limiting case of classical mechanics this is impossible, the binding force in the space x, y, z being infinitely great. Rest energy is interpreted as zero-point energy of the transverse motion in the U-direction. These ideas are illustrated by application of a plane light-wave. The theory is taken over into Dirac's equations. H. L. B.

1453. Multiplication of Quantum-Mechanical Quantities. Part II. P. Jordan. *Zeits. f. Physik*, 87. 7–8. *pp.* 505–512, *Jan.* 26, 1934.—The associative law of multiplication relating to magnitudes occurring in quantum theory is interpreted along lines based on the work of v. Neumann, Wigner and the author. [For Part I, see Abstract 1340 (1933.)] J. S. G. T.

1454. Hydrogen Molecular Ion. G. Jaffé. *Zeits. f. Physik*, 87. 7–8. *pp.* 535–544, *Jan.* 26, 1934.—It is well known that the wave-mechanical problem of the H_2^+ ion is separable in elliptic coordinates ζ, η and ϕ. Up to the present there has only been a strict theoretical analysis of the η-equation, the ζ-equation having been treated only by approximate or numerical methods. This paper contains an analysis of the ζ-equation. The eigenfunctions are obtained in the form of a convergent power series and the eigenvalues from a continued fraction. From these the strict conditional equations for the eigenvalues of the H_2^+ problem are deduced; they are compared with previous calculations. J. E. K.

1455. Equivalent Wave Equations and Interpretation in Differential Geometry. E. Reichenbächer. *Phys. Zeits.* 35. *pp.* 150–160, *Feb.* 15, 1934.—The author discusses the replacement of the second-order wave equation by two first-order equations; he does not find it necessary to introduce more than this number (with the corresponding wave functions) on account of relativity considerations. The interpretation of his results is fully discussed. The results may be expressed with considerable mathematical simplicity in terms of a differential geometry in a non-Riemannian manifold. T. L. M.

1456. Theory of Elementary Particles. L. Goldstein. *Comptes Rendus*, 198. *pp.* 454–456, *Jan.* 29, 1934.—The problem is investigated as to whether Dirac's relativistic quantum theory leads to an intrinsic property of the elements whose behaviour, under certain exterior influence or under an " exterior nul action," it defines. The following theorem is arrived at: the introduction, into the restricted theory of relativity, of the Planck constant h, in order to obtain the wave equation associated with a particle conforming with certain specified conditions causes to be attributed to the particle a fundamental property interpreted as intrinsic kinetic moment, characteristic of the particle, and of absolute numerical value $h/4\pi$. Hence no equation satisfying the given conditions can be associated with any particle whose characteristic kinetic moment differs from this value. [See following Abstract.] N. M. B.

1457. Theory of the Electric Charge. L. Goldstein. *Comptes Rendus*, 198. *pp.* 549–551, *Feb.* 5, 1934.—Considerations previously discussed [see preceding Abstract] are extended to charged particles, and lead to the theorem that the relativistic wave equation associated with an absolute electric charge e, rest-mass m, and intrinsic kinetic moment $h/4\pi$, and satisfying the correspondence principle and other specified conditions leads to a fundamental property of the charge which can be interpreted as its characteristic intrinsic magnetic moment, of absolute numerical value $eh/4\pi mc$, where c is the velocity of light *in vacuo*. Hence a wave equation representing the motion of the particle in an external electromagnetic field cannot be associated with any particle not having such an absolute magnetic moment. N. M. B.

1458. Theory of Quantisation of Matter. L. Goldstein. *Comptes Rendus*, 198. *pp.* 716–718, *Feb.* 19, 1934.—The fundamental limitation previously deduced [see preceding Abstract] for the relativistic quantum theory is shown to be equivalent to a first quantisation of matter. The relativistic quantum equation for a moving particle is resolved into two linear equations satisfying the conditions previously specified, and this method of introducing the Planck constant gives to particles, for which the relativistic equation defines the energy, an intrinsic fundamental property interpreted as kinetic moment. N. M. B.

1459. Waves and Photons. Part I. A. Proca. *J. de Physique et le Radium*, 5. *pp.* 6–19, *Jan.*, 1934.—The author attacks the problem of reconciling the classical theory of radiation expressed by Maxwell's equations, with the quantum theory expressed to a first approximation by Schrödinger's wave equation. As shown previously [see Abstract 483 (1934)] a single potential function ψ can be defined which when acted upon by a system of operators of a special kind involving differentiations of negative and fractional orders, generates six functions which if substituted for the components of electric and magnetic force, satisfy Maxwell's equations. This potential function ψ is now identified with the wave function of Schrödinger. If for ψ the solution of Schrödinger's wave equation appropriate to photons of energy $h\nu$, is adopted, the total energy of the electromagnetic field, calculated by the classical procedure from the electric and magnetic force components derived from ψ in the way indicated above, comes out to be precisely $h\nu$. It is also shown that the electric and magnetic force components derived from ψ behave satisfactorily when subjected to a Lorentz transformation. On the other hand, the energy density in the field is different when computed from ψ via the force components than via a wave mechanics argument. This discrepancy is regarded as crucial and it is suggested that the classical expression for energy density, $1/8\pi (E^2+H^2)$, is valid only as a first approximation appropriate to plane waves forming a narrow pencil of waves differing slightly in direction and frequency. The possibility of an experimental test of the hypothesis is discussed. W. S. S.

1460. Quantum Mechanics of Photons. Pauli's Approximation. A. Proca. *Comptes Rendus*, 198. *pp.* 452–454, *Jan.* 29, 1934.—Defining the movement of a photon by a Dirac equation, a solution is found for the components of the corresponding luminous field. The light corresponding to a photon of negative energy is considered. It is assumed that a photon corresponds always to light, circularly polarised in a certain sense for positive energy, and in the opposite sense for negative energy ; superposition therefore gives linear polarisation, and hence the assumption of photons of negative energy is essential. It is suggested for the interpretation of negative energy of particles in general that the energy must be essentially positive, but its sign indicates the sense of rotation of certain components of the associated field ; in the case of a photon this is Maxwell's electromagnetic field, and in the case of an electron the field is derived from the wave function. [See Abstract 958 (1934) and preceding Abstract.] N. M. B.

1461. Free Paths and Transport Phenomena in Gases and the Quantum Theory of Collisions. Part II. Laws of Force between Atoms and Molecules. H. S. W. Massey and C. B. O. Mohr. *Roy. Soc., Proc.* 144. *pp.* 188–205, *March* 1, 1934.—It has been shown in a previous paper [see Abstract 3940 (1933)] that it is important to use the quantum theory of collisions for the determination of the laws of interaction between atoms at large distances from observations of transport phenomena and free paths. In the present paper, the form and magnitude of the interaction energy between two He atoms is discussed in terms of observations of the viscosity of He at different temperatures. The interaction between He and He^+ is considered with reference to the mobility of He^+ ions in He. Finally, formulæ are obtained which facilitate the determination of the law of force between atoms at large distances by direct measurements of free paths. AUTHORS.

See also Abstracts 1387, 1579, 1719.

RELATIVITY AND ETHER.

1462. Michelson-Morley Experiment. A. A. Merrill. *Frank. Inst., J.* 217. *pp.* 223–225, *Feb.*, 1934.—The author explains the negative result of the Michelson-Morley experiment by an analogy with handicapping, and Huygens' explanation of the significance of refractive indices, *viz.*, the *motion* of light, not its velocity, is slowed when the light passes through a dense but transparent medium. J. S. G. T.

1463. Projective Differentiation of Spinors. O. Veblen and A. H. Taub. *Nat. Acad. Sci., Proc.* 20. *pp.* 85–92, *Jan.*, 1934.—The authors develop the theory of co-variant differentiation of spinors, introduce assumptions about the co-variant derivatives of the fundamental spinors of the projective relativity theory, and establish the consistency of these assumptions. T. L. M.

1464. Trajectories in the Problem of Three Bodies in Relativity. M. Kiveliovitch. *Accad. Lincei, Atti,* 18. *pp.* 494–501, *Dec.* 3, 1933.—Works out in detail a number of theorems, applicable also to the corresponding problems in Newtonians. A. D.

See also Abstracts 1455, 1456.

SOLUTION.

1465. Kinetic Interpretation of the Activity Coefficients of Non-Electrolytes. J. W. Belton. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 499–501, *Jan.*, 1934.—The activity coefficient of a slightly soluble non-electrolyte in a salt solution is equal to the ratio of its solubilities in pure solvent and in the salt solution. The equilibrium between solid and saturated solution is considered from the dynamic point of view, the rate of solution being equated to the rate of deposition. The expression obtained for the salt solution differs from that for the pure solvent by a term representing the electrical work in passing from the solid to the liquid, due to the presence of adsorbed ions. An approximate calculation of this work is carried out, leading to an expression for the activity coefficient f which indicates, in harmony with experiment, that the ratio of $\log f$ to the ionic strength will be constant, provided that the degree of adsorption is small. L. A. W.

1466. Solubility of Vapours in Gases. W. MacFarlane and R. Wright. *Chem. Soc., J. pp.* 207–210, *Feb.*, 1934.—The lowering of the saturated vapour pressure of a liquid in the presence of a soluble gas may be attributed to the ordinary lowering of the vapour pressure caused by a solute, and does not preclude the possibility of attraction between the two constituents of the vapour phase. The attraction between the vapours of methyl alcohol, ether, acetone, or chloroform, and CO, NH_3, SO_2 or HCl was determined either qualitatively or quantitatively. Equal volumes of a gas and of air saturated with vapour were mixed and the change of pressure at constant volume was observed. It is shown that very soluble gases show great attraction for the vapours of the liquids in which they are soluble, but the relation does not appear to be expressible quantitatively. P. H. B.

1467. Cryoscopic Investigation of the Degree of Hydration of the Ions of Nickel Chloride in Aqueous Solution. (Miss) O. Hun. *Comptes Rendus*, 198. *pp.* 740–742, *Feb.* 19, 1934.—By determining the cryoscopic constants in salt solution and in pure water, as observed with resorcinol, and allowing for the polymerisation of the resorcinol [see Abstract 3198 (1933)], the apparent degree of hydration of $NiCl_2$ in aqueous solution (expressed in mols. of H_2O per mol. of $NiCl_2$) is found to be 28·5 in 0·5 molar solution and 33·1 in 0·25 molar solution. L. A. W.

1468. Cryoscopic Determination of the Degree of Hydration of the Ions of Barium Chloride in Aqueous Solution. E. Rouyer. *Comptes Rendus*, 198. *pp.* 742–744, *Feb.* 19, 1934.—Using the same method as in the preceding abstract, the apparent degree of hydration of $BaCl_2$ in aqueous solution (expressed in mols. of H_2O per mol. of $BaCl_2$) is found to be 26·1 in 0·5 molar solution and 29·1 in 0·25 molar solution. From a comparison with previous determinations with other salts it is noted that the degree of hydration, as determined cryoscopically, decreases for the chlorides of the alkaline earth metals with increase of the atomic weight of the metal. By the method of solubilities, on the contrary, the inverse behaviour is found. L. A. W.

1469. Calculation of Volumetric Composition of Fluid Mixtures. S. H. Ingberg. *Physics*, 5. *pp.* 64–70, *March*, 1934.—The mathematical treatment is developed relating to mixture of fluids in a container maintained at constant pressure and volume, assuming perfect and instantaneous diffusion, free efflux and no reaction between the components of the mixture. For comparison, the equations are given for mixture within a container from which no efflux takes place, and also a treatment applicable to intermediate conditions. Specific applications are developed pertaining to conditions involving inert gas, such as carbon dioxide, flue gas or engine exhaust gas, released into an enclosure by automatic or manual means to extinguish fire, and to the subsequent ventilation of spaces thus deluged to reduce the toxic gas content and raise the oxygen content to limits making such spaces safe for entry. AUTHOR.

See also Abstracts 1427, 1469.

SURFACE TENSION AND COHESION.

1470. Surface Tension of CCl_4 at Low Temperatures. T. Alty and G. F. Clark. *Canad. J. of Research*, 10. *pp.* 129–133, *Jan.*, 1934.—The variation of the surface tension of CCl_4 with temperature has been determined with considerable accuracy between + 12° C. and − 10° C.

AUTHORS.

1471. Surface Tension of Mercury in a Vacuum and in Presence of Hydrogen. R. S. Bradley. *J. Phys. Chem.* 38. *pp.* 231–241, *Feb.*, 1934.—Sufficient specially purified mercury was distilled in an enclosed apparatus into a cup of diameter 5·5 cm. so that the mercury surface formed a " flat drop " above the top of the cup. The position of the top of the drop was determined by means of a Bourdon gauge having a sensitivity of 2 mm. per 1 mm. change in pressure. Readings on the mercury surface could be repeated to 0·001 mm. pressure measured by a Hamblin gauge. The height of maximum section was located by a horizontal telescope using a horizontal slit in the usual manner. The temperature was constant within 1° C. The surface tension remained constant during observations extending over several weeks, but differed from the mean by about ± 1 dyne/cm. when fresh distillations were used. The surface tension was not affected by earthing the mercury. The mean result obtained by Worthington's formula, which for these experiments agrees with Ferguson's formula to about 0·2 %, was 500·3 dynes/cm. at 16·5° C. Further experiments were made in specially prepared pure hydrogen. A very slow decrease in surface tension initially of the order of 1 dyne/cm. per day occurred. At low pressures the final value of the surface tension decreased with increasing pressure, but from 8 mm. to 100 mm. no change was observed. The results are interpreted theoretically on the assumption that the slow fall in surface tension is accompanied by a slow adsorption. A study was also made of desorption from the surface when a hard vacuum was restored. The effect of illumination by a mercury vapour lamp was not immediate, but the rate of decay after illumination was greater than normally. P. H. B.

1472. Mobility of Molecules in Surface Films. S. E. Bresler, B. A. Talmud and D. L. Talmud. *Phys. Zeits. d. Sowjetunion*, 4. 5–6. *pp.* 864–872, 1934. *In German.*—The mobility of the molecules in monomolecular films was determined by forcing the film through a " capillary surface " (*i.e.*, a passage about 20 mm. long and between 0'5 mm. and 2mm. wide), and measuring the change with time of the surface pressure on either side of the capillary. An expression is deduced for the speed of flow of a two-dimensional membrane through such a capillary surface in terms of the special viscosity of the film and the resistance of the underlayers. Experimental results show that the mobility of the molecules in the surface film is a minimum when the resistance to movement of the film is a minimum [see Abstract 2062 (1931)]. P. H. B.

1473. Structure of the Surface Film of a Liquid. W. P. Berdennikoff, S. E. Bresler, I. L. Zelmanoff and E. A. Strauff. *Phys. Zeits. d. Sowjetunion*, 4. 5–6. *pp.* 873–884, 1933. *In German.*—It is discussed whether the quasicrystalline complex existing in a liquid up to a considerable depth (10^{-6} cm.) at an interface is oriented. To obtain an idea of the thickness of semi-solid films on the surfaces of liquids the formation of bubbles in molten paraffin at temperatures in the neighbourhood of freezing was observed. It is shown that the wall thickness of a " black " bubble does not exceed 10^{-6} cm. A method of obtaining

X-ray diffraction patterns from a liquid is described, and the results obtained demonstrate the existence of a highly oriented quasi-crystalline structure in the liquid surface. P. H. B.

1474. Thermodynamics of Electrocapillary Curve. F. O. Koenig. Part I. *J. Phys. Chem.* 38. *pp.* 111–128, *Jan.*, 1934.—Although the existing theories of the electrocapillary curve lead to a common essentially correct result, that due to Lippman, Helmholtz and Planck is incomplete, in that it does not give an account of the variation of the electrocapillary curve with composition, and the " Gibbs theory " is based on the false assumption that the mercury surface is always in equilibrium with Hg_2^{++} and Hg^{++} ions in the solution adjacent to it in the capillary. A fresh theory is based on " perfect polarisability," *i.e.*, impermeability of the boundary layer between two conducting phases to electrically charged particles, which corresponds closely to the actual conditions in the Lippman electrometer. The resulting general equations add some electroneutrality conditions to the Gibbs equations for any boundary layer in equilibrium. The Lippman-Helmholtz equation is found to depend upon no other assumption than that of perfect polarisability, and therefore holds for all perfectly polarisable systems regardless of their composition. P. H. B.

1475. Capillary Electrometer with Reduced Capacity. R. Havemann. *Zeits. f. Elektrochem.* 40. *pp.* 117–119, *March*, 1934.—A modified capillary electrometer is described in which the capacity is materially reduced, and other disadvantages of the instrument are avoided. Only a short capillary is used, containing a drop of mercury in a widened portion at the top. The sensitivity of the instrument is increased by a reduction of the capacity. Provision is made whereby the air pressure in the instrument can be varied at will. F. J. B.

See also Abstract 1370.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

1476. Quartz Clocks. A. Scheibe and U. Adelsberger. *Hochfrequenztechn. u. Elektroakustik*, 43. *pp.* 37–47, *Feb.*, 1934. *From the Reichsanstalt.*—A detailed technical description is given of the quartz clocks installed at the Physikalisch-Technischen Reichsanstalt. Particulars are given of the quartz rods used and of their mountings and operating circuits. The next section deals with the various amplifying and frequency selection stages leading to the synchronous motor and time marking apparatus. The apparatus for measuring the instantaneous rate and the frequency variations of two quartz clocks is also described. A. W.

1477. Personal Equation. E. v. Skramlik. *Naturwiss.* 22. *pp.* 98–105, *Feb.* 16, 1934.—A *résumé* of our knowledge as to the personal equation in astronomical observations and its variations from observer to observer and in one and the same observer. In a given observer its variaions are, say, 400 times those of the best pocket-watch or 1,000,000 times those of a quartz clock. Methods of investigation and tabulated data are given. A. D.

See also Abstract 1502.

VACUA, HIGH.

1478. Safety Valve for Shortened McLeod Gauge. W. v. Meyeren. *Zeits. f. techn. Physik*, 15. 2. *pp.* 51–52, 1934.—A valve to prevent the accidental entry of mercury from the McLeod gauge into the vacuum apparatus is described. A small pear-shaped bulb is blown in a vertical tube between the gauge and the rest of the apparatus. The connection to the apparatus is taken off horizontally just above the bulb. In the bulb is a glass bell hanging mouth downwards at the bottom of a vertical glass rod. The bell plus rod is free to move vertically within limits. It is raised by the rising of mercury into the bulb, thus making a mercury-tight joint with the upper part of the bulb against which the bell is forced. The author claims that the device is reliable, whether the mercury rises to it quickly or slowly. No grease is used. P. H. B.

VISCOSITY, FRICTION AND LUBRICATION.

1479. Viscosity of Strong Lithium Chloride Solutions at Low Velocity Gradients. G. W. S. Blair and R. K. Schofield. *Phil. Mag.* 17. *pp.* 225–229, *Feb.*, 1934.—Measurements of the logarithmic decrement of a cylinder executing rotational oscillation while immersed in a strong lithium chloride solution revealed no inconstancy in the viscosity, even though the final amplitude was so small that the maximum velocity gradient was only 0·003 $\mathrm{sec.}^{-1}$ The data confirm and extend that obtained by Ostwald and Malss using a capillary viscometer in which the velocity gradient at the wall for the lowest stress was 0·6 $\mathrm{sec.}^{-1}$ The anomalies reported earlier by the authors [see Abstract 2532 (1931)] appear to have been due to the ability of the strong salt solutions used to " creep " under the rubber sleeves which held the capillaries in place, a property not shared by the glycerin-water mixture used to check the standardisation of the apparatus. On sealing the joints, the anomalies in the case of the lithium chloride solution disappear, but the clay pastes still show a characteristic behaviour including departure from the R^4 law. The flow-meter used in this work has proved itself both trustworthy and convenient in operation. AUTHORS.

1480. Theory of the Viscosity of Liquids. Part II. E. N. da C. Andrade. *Phil. Mag.* 17. *pp.* 698–732, *March*, 1934.—It is considered that, when the molecules of a liquid oscillating about a slowly displaced centre [see Abstract 988 (1934)] combine momentarily with molecules of another layer, there will be a sharing of momentum parallel to the drift. This sharing will only take place if the orientation is favourable, and further these groups of favourable molecules will be disturbed by heat agitation. On this consideration the equation $\eta^{v1/3}=A^{c/v}T$ is obtained for variations of viscosity with temperature. A and c are arbitrary constants and v is the specific volume. Experimental results agree with the equation for all liquids except water and certain tertiary alcohols. In a large number of substances c is proportional to the total internal energy as derived from van der Waals' equation. An equation is obtained for change of viscosity with temperature. The question of associated liquids, the anomalous behaviour of water, certain alcohols and mercury, and the inclusion or omission of the compressibility factor in the temperature variation are discussed. H. M. B.

See also Abstract 1472.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

See Abstracts 1477, 1498, 1499, 1500, 1501, 1510.

COMETS AND METEORS.

1481. Parabolic Orbit of Meteor Shower of 1933, October 9. L. Gialanella. *Accad. Lincei, Atti,* 18. *pp.* 566–570, *Dec.* 17, 1933. [See also Abstract 5197 (1933).]

1482. Light of Shooting Stars. J. Mascart, C. Fabry. *Comptes Rendus,* 198. *pp.* 544–549, *Feb.* 5, 1934.—The various mechanical theories of the origin of the light from a meteorite deduce temperatures of from 2358° to 10,800° or higher according to the assumptions made, in any case sufficient to raise the meteorite and gas in close contact therewith to incandescence, whilst iron would, though stone would not, withstand the calculated pressure of 675 atmospheres. It is therefore unnecessary to have recourse to any electron theory such as that the light is due to bombardment of the meteorite by electrons in the Heaviside layer (Burgatti). Fabry, though agreeing as to the sufficiency of a mechanical cause, points out that the spectra of meteorites indicate emission by gases and not by an incandescent solid, and that the persistent trail lasts much longer than can be explained by its consisting of incandescent solid particles ; it must therefore be due to luminous gas, *e.g.*, such as active nitrogen. C. A. S.

COSMOGONY.

1483. Evolution of Expanding Universe. G. Lemaître. *Nat. Acad. Sci., Proc.* 20. *pp.* 12–17, *Jan.,* 1934.—The author extends his theory of collapsing-regions and equilibrium-regions in a spherical universe [see Abstract 2818 (1933)], analysing new data as to fields of nebulæ [see Abstract 3981 (1933)]. The mass of a nebula is found to be 1 or $3 \times 10^9 \odot$, with less uncertainty than previously supposed. The gravitational energy due to the contraction would provide mechanism for formation of the stars, if the initial nebulæ were gaseous or meteoritic. An intermediate type of region, slowly collapsing but containing rapidly collapsing regions, could be identified with our galaxy. The author concludes that all problems connected with extra-galactic nebulæ may be accounted for by applying statistical mechanics to small inhomogeneity in the idealised model.
T. L. M.

1484. Expansion of the Universe and Intensity of Cosmic Rays. P. S. Epstein. *Nat. Acad. Sci., Proc.* 20. *pp.* 67–78, *Jan.,* 1934.—The author discusses the energy decrease of photons for the homogeneous (Friedmann) universe, showing that the energy of observed corpuscles is proportional to the radius of the universe at the time of emission. He analyses the possible types of expansion, with reference to Zwicky's theory of the limited range of a light quantum. If the cosmological constant is not positive, the time-scale is too short ; if positive the range of a quantum depends on the constant and can assume all possible values up to infinity. The difficulty of the relative intensity of cosmic rays remains, and if they are not emitted under special conditions (as by super-radioactive materials) the difference of range may be accounted for by interstellar absorbing matter in the form of dust. T. L. M.

1485. Relationship between Cosmic and Atomic Quantities. K. Sitte and W. Glaser. *Zeits. f. Physik*, 88. 1–2. *pp.* 103–107, *Feb.* 21, 1934.—To find a relation between cosmic and atomic quantities it would be necessary to measure out geometrical elements of the universe by means of elementary particles (electrons or protons). For example, by giving the coordinates of all the 2N elements of structure, it would be possible to determine the radius of curvature R of Einstein's world. But since we can specify at most 2N−1 particles (for we retain the last as a probe for measuring the coordinates of the others), it is impossible to make an accurate measurement, and hence it is impossible to define the centre of gravity of the world to within a greater accuracy than a definite value Δ. In conjunction with the indeterminacy relation this leads to the desired relationship. A discussion is given of the inferences drawn from this relationship and its bearing on formulæ given by Eddington and Haas.
H. L. B.

See also Abstract 1491.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1486. Qualitative Characteristics in the Restricted Problem of Three Bodies in a Gravitating Medium. Natalie Rein. *Accad. Lincei, Atti*, 18. *pp.* 451–458, *Nov.* 19, 1933.—An investigation from the qualitative point of view is given of the problem (analogous to the restricted problem of three bodies) of the motion of a particle in a medium with density distributed according to a given law, which medium attracts the particle and resists its motion. Hill's method, relating to the qualitative characteristics given by the surface of zero relative velocity, is employed, and the results obtained are similar to those obtained for the classical case of the restricted problem. A. J. McC.

1487. Evolution of Rotating System of Material Particles, with Applications. B. Lindblad. *Roy. Astron. Soc., M.N.* 94. *pp.* 231–240, *Jan.*, 1934.—A theorem is proved regarding the motion of material particles in a fixed gravitational field of rotational symmetry and symmetry about the equatorial plane. The ultimate result of encounters and collisions is shown to be that the particles all describe circular orbits in the plane of rotation, forming a flat ring. Applications to the rings of Saturn and to the possible mechanism of a meteoritic hypothesis of the origin of the solar system are quoted. A fuller discussion is given of the relation between the expulsion of particles from the Galaxy and the packing of matter towards the galactic plane. It is shown to be conceivable that increasing flattening may lead to instability and the appearance of spiral arms; and a general order of galactic evolution is sketched. T. L. M.

1488. Trajectories Giving Approach to Centre of Force, Commencing from a Given Keplerian Orbit. A. J. Sternfeld. *Comptes Rendus*, 198. *pp.* 711–713, *Feb.* 19, 1934.—Required to find the minimum impulse to change the orbit into one passing through a given point nearer the central body: the solutions considered require two impulses, one producing an ellipse receding from the first, the other a more elongated one attaining the required point. The conditions in which this would be advantageous, velocities required, and time taken are considered. The author points out that the problem of minimum impulse would be important in interplanetary navigation. T. L. M.

See also Abstract 1508.

LATITUDE AND LONGITUDE.

See Abstract 1502.

NEBULÆ.

1489. Coal-Sack Nebula. R. Müller. *Zeits. f. Astrophysik,* 8. *pp.* 66–74, *Feb.,* 1934.—Counts of stars in the Coal-Sack show that the star density within it differs from that in the rich surrounding region, but does not differ much from the mean density of the Milky Way in general; and estimates of its total luminosity prove that the apparent blackness is an effect of contrast. All its stars lie beyond a nebulous cloud, which has an almost uniform absorbing power of one magnitude, and cannot be more distant from us than 150 parsecs. M. A. E.

1490. Calcium Clouds. O. Struve. *Astrophys. J.* 79. *pp.* 273–279, *April,* 1934.—The existence of condensations in the interstellar cloud of gas is inferred from a comparison of distances determined by means of the effect of galactic rotation and by means of the intensities of interstellar CaII lines. From the absence of any measurable second-order effect of galactic rotation in the radial velocities determined from interstellar lines, the distance of the galactic centre is estimated to be at least 10,000 parsecs. AUTHOR.

1491. Forms of the Nuclei of Extra-Galactic Nebulæ and the Cosmical Repulsion. G. Armellini. *Accad. Lincei, Atti,* 18. *pp.* 342–346, *Nov.* 5, 1933.—Explanations of the observed recession of the extra-galactic nebulæ at a velocity proportional to their distance can be placed under one of three categories: (1) relativistic explanations founded upon the modern theory of the expanding universe; (2) optical explanations based on modifications in the quanta of energy in traversing space; (3) mechanical explanations based on the hypothesis that the force between two masses consists of the ordinary Newtonian attraction together with an additional small repulsive force (cosmical repulsion) proportional to the distance. Assuming the third explanation, the forms of the nebulæ are investigated, and it is shown that a fluid at rest can assume either a stable spherical form or an unstable spheroidal form. A. J. McC.

1492. Spatial Distribution of Extra-Galactic Nebulæ Within 4000 Kiloparsecs Radius. J. H. Reynolds. *Roy. Astron. Soc., M.N.* 94. *pp.* 196–203, *Jan.,* 1934.—The author divides extra-galactic nebulæ into: (1) irregulars which are few but include the Magellanic clouds; (2) spirals which must have a minimum diameter of 5′ for the 4000 kiloparsecs radius and of which we must therefore know at least 90 % over the whole sky; (3) ellipticals which are numerous but small and are mostly beyond the adopted distance. Four criteria are used for nebular distances; (1) angular diameters; (2) integrated magnitudes; (3) observation of various stellar classes in the nearer systems; and (4) degree of spectrum shift corrected for galactic rotation. The last is the best criterion since here is a direct relationship between shift and distance. A table and diagram show the comparative dimensions of the extra-galactics and our galaxy; these indicate the former's small dimensions as compared with ours, and also that there is difference of mass even where diameters are the same. Tables and diagrams also give the distribution of the spirals and irregulars in the N. and S. galactic hemispheres; the southern systems are both nearer and larger than the northern. Spirals of from 5′ to 16′ diameter preponderate in the N. galactic hemisphere.

There is a considerable range of diameters in spirals of from 5′ to 9′ diameters, but a diameter of 6000 parsecs would be much above the average. The author concludes that the great preponderance of the extra-galactics in the S. galactic hemisphere within 700 kiloparsecs, and the considerable preponderance of such systems in the N. galactic hemisphere from this radius up to 4000 kiloparsecs seems to be well established.
A. S. D. M.

1493. Diameter of Andromeda Nebula. J. Stebbins and A. E. Whitford. *Nat. Acad. Sci., Proc.* 20. *pp.* 93–98, *Feb.*, 1934.—Photo-electric photometry of a number of spiral nebulæ gives greater diameters than direct photographs. Detailed measurements across the Andromeda nebula show a certain extension of 25 % over photographic dimensions, and a probable extension to twice the latter. This may lead to dimensions comparable with our galaxy. The central part is brighter than any part of our galaxy may appear from outside. At a distance of 4000 parsecs from the centre, the brightness is comparable with Seares' estimate for our neighbourhood. The supposed difference in scale between the two systems is thus likely to be reduced greatly. T. L. M.

PLANETS.

1494. Periodic or Secular Changes of Velocity on Jupiter. A. S. Williams. *Roy. Astron. Soc., M.N.* 94. *pp.* 240–246, *Jan.*, 1934. —The systematic observations of the last half-century give no indication of any long-period periodicity in the velocity of the equatorial current of Jupiter, but they do indicate the existence of a short period periodicity of about 2½ years, having an amplitude or range of about 9 km./hour in velocity. Between 1879 and 1928 the rotation period of the south equatorial current increased in length from $9^h\ 49^m\ 59^s$ to $9^h\ 50^m\ 45^s$, a difference of 46^s, meaning a *decrease* of 55 km./hour in the velocity of the current. The changes in the motion of the north equatorial current have been more irregular, and sometimes differ considerably from those of the south equatorial current. AUTHOR.

1495. Colour-Filter Photometry of Mars. N. Barabascheff and B. Semejkin. *Zeits. f. Astrophysik*, 8. *pp.* 44–55, *Feb.*, 1934.—As part of a general study of planetary photometry at Kharkov observatory, photographs of Mars with red, yellow, and blue filters have been measured with the Koch microphotometer. Lambert's Law holds for the surface. Scattering follows Rayleigh's equation except for the blue filter, which gives wide divergence. Albedoes and transmission coefficients are given. The brightness of several regions in 20° longitude (Argyre, Oxia, etc.) agrees with that found by Götz. Special albedoes for red radiation are: deserts, 0·153; seas, 0·133; polar regions 0·220. T. L. M.

1496. B Band of Oxygen in the Spectrum of Mars. W. S. Adams and T. Dunham, Jr. *Mt. Wilson Observat. Contrib. No.* 488. *Astrophys. J.* 79. *pp.* 308–316, *April*, 1934.—Ten spectrograms of Mars covering the region of the B band of oxygen were obtained in the first order of the 9-foot grating spectrograph at the coudé focus of the 100-inch reflector during the autumn and winter of 1932–1933. During the interval covered by the observations, the radial velocity of the planet relative to the earth varied from − 13·8 to + 12·6 km./sec. The linear scale of the spectrograms was 5·6 Å/mm. Measures of the wave-lengths of about thirty oxygen lines on each of the ten spectrograms relative to lines of solar origin showed a mean displacement of but 0·0011 Å from the position of the telluric oxygen lines. The contours of the oxygen lines were also investigated with the microphotometer and compared with the theoretical contours on the assumption of a ratio of 1 : 1000 in the relative abundance of molecules of free oxygen in the atmospheres of Mars and the earth. The final conclusion is that the amount of oxygen in the atmosphere of Mars is probably less than 0·1 % of that in the earth's atmosphere over equal areas of surface. AUTHORS.

1497. Place of Origin of the Moon. F. Nölke. *Gerlands Beitr. z. Geophys.* 41. 1. *pp.* 86–91, 1934.—The objections to the theories of Pickering, Darwin, Jeffreys [see Abstract 1134 (1931)] and Laplace are summarised, and a modification of the last suggested: that in pre-geological times the combination of more rapid rotation and a more extended and denser atmosphere resulted in a balance of gravity and centrifugal force in the upper atmosphere above the earth's equator. This resulted first in a ring formation, the ring then ruptured and condensed to form the moon, with no production of any definite scar on the earth's surface. C. A. S.

See also Abstract 1487.

STARS.

1498. Apparent Diameter of Stellar Discs. L. Roy. *Comptes Rendus*, 198. *pp.* 304–306, *Jan.* 22, 1934.—The author has measured the apparent diameter of the discs of a range of stars between magnitudes 0 and 5½ for apertures of 50 to 300 mm. and varying magnifications. He considers a "surface of apparent diameters," in which the diameter is plotted as a function of both magnitude and aperture; it was found to be sensibly independent of magnification. The properties of the surface are discussed. [See following Abstract.] T. L. M.

1499. Focal Images of Stars. L. Roy. *Comptes Rendus*, 198. *pp.* 416–419, *Jan.* 29, 1934.—The author applies his observations [see preceding Abstract] to the theory of the illumination of points at varying angular distances from the centre of the focal image of a star. For double stars of equal magnitude, elongation would begin to be apparent at 73″·7/D, D being the aperture in mm. The commencement of separation occurs at 110·5″/D. The form of the figure-of-eight curves which limit the central image is discussed. This suggests possible causes of error in estimating the distance of close doubles. [See following Abstract.] T. L. M.

1500. Separating Power for Two Equal Components. L. Roy. *Comptes Rendus*, 198. *pp.* 523–525, *Feb.* 5, 1934.—The author applies his discussion [see preceding Abstract] of the form of the image of a close double star to the derivation of the wrongly-named constant of separation, *a*. This is shown to be a calculable function of the aperture D and the magnitude of the component stars; and to vary between 110″·5 and 234″·5; the value of Dawes, 111″·8 is verified within 1 % for his conditions, magnitude 6, aperture 1 inch. The true separating power is then *a*/D. For very close doubles the apparent separating power is smaller than the true separating power. [See following Abstract.] T. L. M.

1501. Conditions of Visibility and Separation of a Companion Star. L. Roy. *Comptes Rendus*, 198. *pp.* 628–631, *Feb.* 12, 1934.—The author discusses the illumination produced by a fainter companion star at points between the central disc and first diffraction ring of the principal star; and the limiting difference of magnitude which permits of visibility of the companion. The case of a companion at the distance of theoretical separating power is specially discussed and illustrated. [See preceding Abstract.] T. L. M.

1502. Atmospheric Distortion of Star Observations for Position and Time. A. J. Bamford. *Roy. Astron. Soc., M.N.* 94. *pp.* 204–228, *Jan.,* 1934.—The author contends that some of the small variations in observation of stars for position are meteorological, and therefore systematic, not accidental, so cannot be deduced by the method of least squares. He summarises his theodolite results at Tel-Abiad in 1919, as that, in latitude observations, the N. and S. circum-meridian stars must be either balanced quickly or else simultaneously observed clock stars for E. and W. differences must be got to correct the latitude observations. The Colombo station is well placed for this research, since its S.W. monsoon has previously passed over the sea alone. Here the clock stars agree better as the wind strengthens, since this straightens out irregular distortion. Star groups are analysed in terms of zenith distance, and during the monsoon season give a curve with definite convexity and with most positive values near the zenith, but not so at other seasons. Zenith stars give relatively later values than lower ones, probably because of decreased refraction. A table and diagram indicate the index of air refraction increases from west to east across the meridian: that is, the stars are observed too soon, but zenith stars are the least affected. At Colombo in low latitudes, this could be brought about by a bank of high optical density, to the east of the meridian during the monsoon, and a diagram (from pilot balloon observations) shows that looking North during the S.W. monsoon, the wind is reduced over the land, and consequently there is banking up of air immediately east of the coast. Longitude determinations at Colombo, 1926–1928, indicate a successive increase in longitude with steeper gradients from the S.W., and emphasis is laid on the comparison between star groups observed under different weather conditions within a single period, not on different values during different periods. Pilot balloon observations, the inadequacy of grouping by months, and the general instrumental question such as pivot and level errors, are discussed. These last as well as the connection of star magnitude with shift of the pole give negative results, and therefore tend to confirm the meteorological explanation. A. S. D. M.

1503. Radial Velocity of δ Ceti. C. C. Crump. *Astrophys. J.* 79. *pp.* 351–356, *April,* 1934.—Variation in the radial velocity of 82 δ Ceti is established. The velocity of the system is approximately +12 km/sec., $P=0^{d}15$; $K=6$ km/sec. The elements may be slightly variable. AUTHOR.

1504. Continuous Absorption and Spectrum of a Stellar Atmosphere of Pure Hydrogen. A. Unsöld. *Zeits. f. Astrophysik,* 8. *pp.* 32–43, *Feb.,* 1934.—For an atmosphere of pure hydrogen the coefficients of continuous absorption, distribution of intensity in the spectrum with special reference to the Balmer limit and the colour-temperature, intensity of the Balmer lines, and maximum central intensity in the Balmer series are computed. Comparison with observation shows that the continuous absorption by metallic elements cannot be very great. T. L. M.

1505. Colour Excess and Interstellar Calcium Line Intensity. E. G. Williams. *Mt. Wilson Observat., Contrib. No.* 487. *Astrophys. J.* 79. *pp.* 280–307, *April,* 1934.—The spectra of 67 stars have been measured for interstellar K-line intensity on spectrograms giving dispersions of 16·6 and 23·5Å/mm. The dispersion is insufficient to give true line shapes, but the total absorption is obtained with a probable error of about 5 %. The spectrophotometric method is described. Comparison with previous intensity estimates shows considerable scatter. The ratio of K to H is 1·61, but a systematic error in the measurement of H in sharp hydrogen-line stars is found to cause this large value. For 12 plates of *n*-line stars, K/H=1·43. The correction to be applied to photoelectric colour indices of B- and A-type stars on account of absorption in the Balmer series has been determined. For Elvey's colour measures of A stars it is about 0·5 mag. The corrected colour excesses from three sources are combined. The average deviation from the mean is $0{\cdot}017^{\mathrm{m.}}$ A statistical correlation is found between colour excess and K intensity. The dispersion indicates that the scattering material and interstellar calcium are not coextensive. The Be stars are too red for their calcium intensity. For the six stars with strongest emission the excess redness on the Madison scale is $+0{\cdot}18^{\mathrm{m.}}$ No dependence of colour excess on the duplicity of the bright lines can be detected. Although the relation of K intensity to colour excess does not change systematically for stars within 26 parsecs of the galactic plane, two stars at greater distances are $0{\cdot}1^{\mathrm{m.}}$ too white for their K intensities. No marked longitude effect is apparent. AUTHOR.

1506. Statistical Study of Rotational Broadening in 112 Stars of Class F. Christine Westgate. *Astrophys. J.* 79. *pp.* 357–360, *April*, 1934.—The width of the spectral line λ 4215 is recorded for 112 stars of class F. A diagram illustrating the frequency of occurrence of different widths among the early and among the late F's shows that appreciable rotation disappears in the middle F's. The frequency diagram for class F is compared with those for classes B and A as determined in previous papers [see Abstracts 2261 and 3977 (1933)]. The indication is that stars of class A have greater velocities of rotation than those of either class B or class F. There is no definite relation between absolute magnitude and rotational velocity. The average observed rotational velocity is independent of galactic latitude, which indicates that the axes of the stars are directed at random. AUTHOR.

1507. Stellar Stability. G. Steensholt. *Zeits. f. Astrophysik*, 8. *pp.* 56–58, *Feb.*, 1934. *In English.*—In this paper the stability coefficient of a stellar model, in which the rate of energy generation proceeds proportionately to T^3 is calculated by methods previously applied to the Atkinson models, [see Abstract 532 (1934)]. The star is found to be unstable, and the astrophysical significance of this fact is briefly discussed. AUTHOR.

1508. Kelvin-Poincaré Problem of Stellar Evolution. V. V. Narlikar. *Roy. Soc., Proc.* 144. *pp.* 28–39, *March* 1, 1934.—A rotating homogeneous liquid mass with assigned angular momentum contracts so as not to violate the principle of degradation of mechanical energy. From the spherical form it passes through the range of stable Maclaurin spheroids and Jacobian ellipsoids. Successive states are tabulated and critical points defined. The next type, the pear-shaped figure, is unstable; but the cataclysm may be quite smooth in its earlier stages; there appears, however, to be no room for the more developed pyriform figures of Jeans. The end configurations (binary) are discussed; the mass ratio of the components is less than 3·4, in keeping with double stars. In an *Addendum* (*pp.* 39–46) **J. Larmor** shows how this sequence illustrates the general theory of dynamical evolution. The essential limitations of evolutionary discussions are emphasised; and the problem is raised whether the discussion of the stability of a configuration is transferable to the stability of a transition. T. L. M.

1509. Molecules in Sun and Stars. H. N. Russell. *Mt. Wilson Observat. Contrib. No.* 490. *Astrophys. J.* 79. *pp.* 317–342, *April*, 1934.—Faint lines in the sun, stronger lines in sunspots and huge bands in red stars are due to molecules. The equation for dissociation for any diatomic molecule is identical in form with that of ionisation. The author follows Milne in the assumptions for temperature and pressure, and he calculates the amounts of various compounds. Hydrides show that hydrogen is abundant and passing from spot to disc, the moderate weakening of the bands arises from dissociation. For stars like the sun with excess of oxygen over carbon, the amounts of H, C, N, O, Ti, and their compounds are calculated from the author's examination of atmospheric extent and pressure in giants and dwarfs; diagrams are given. The predicted maximum intensity of TiO is higher in giants than dwarfs, and S stars belong to the oxygen group, and probably contain more Zr than normal. For long-period variables dissociation of compounds causing the excitation of metallic emission lines is possible, but weakening of the sodium lines at minimum cannot be explained as due to conversion to an oxide or fluoride. Stars with excess of carbon over oxygen resemble R and N Stars, and dwarf stars with this excess should show R and N spectra, but no carbon dwarf star has yet been found. Stars of intermediate composition should exhibit spectra as of peculiar examples of class M, R, or N. A. S. D. M.

1510. Double Star Measurements with a Simple Interferometer. W. S. Finsen. *Union Obs. S. Africa, Circ.* 90. *pp.* 379–382, *Aug.* 15, 1933.

1511. Period of Eclipsing Variable, R Canis Majoris. J. Ellsworth. *Comptes Rendus*, 198. *pp.* 445–447, *Jan.* 29, 1934.—An analysis of the observations of the variation of period of this star leads to the conclusion that it consists of an eclipsing variable of period about 1 day, the component stars being about 0·003 astronomical units apart, which itself rotates around a third body with period 44 years in a orbit whose radius is about 10 astronomical units. G. C. McV.

1512. Photometric Study of β Lyrae. H. U. Sandig. *Zeits. f. Astrophysik*, 8. *pp.* 1–31, *Feb.*, 1934.—The calibration of the filters and the Hopmann photometer used are fully described. The star was observed from May to December, 1931, with blue and yellow filters; at least one of two comparison stars was found to show irregular variations. The light curves indicate an abnormal disturbance about the middle of July. Thereafter the difference between the blue and yellow observations is greater and the secondary minimum about one-tenth magnitude deeper in the yellow. A discussion of the light-curves by Russell's method gives the B8 component totally eclipsed at principal minimum, whence an inclination of over 70° is deduced. For the blue the introduction of limb darkening improves the fit greatly; this is unusual for stars of this type; but the yellow curve requires only slight darkening. These results generally confirm those of Danjon. It was not possible to derive elements from the yellow observations after July. The results of a colour-index programme of observations are also given and temperatures deduced on Brill's scale: B5 component, 15,000°; B8 component, 11,000°. T. L. M.

1513. HD 33232, Long-Period Spectroscopic Binary of Class Be. P. W. Merrill. *Mt. Wilson Observat., Contrib. No.* 491. *Astrophys. J.* 79. *pp.* 343–350, *April*, 1934.—The spectrum of HD 33232 combines features of types nB3 and cA0. $H\beta$ has an emission fringe which shifts from the red to the violet edge as the position of the absorption line changes.

Displacements of lines of H, Fe II, Mg II, Ca II, Si II and III, are given in a table. The data for H give a well-defined curve of variation from which the following orbital elements were computed: $P = 3710$ days, $e = 0{\cdot}31$, $K_1 = 31{\cdot}5$ km/sec., $a_1 \sin i = 1{,}528 \times 10^6$ km., $m^3_2 \sin^3 i/(m_1 + m_2)^2 = 10{\cdot}4 \odot$, indicating, if the two components are equally massive, a minimum systemic mass eighty-three times that of the sun. Iron, silicon and magnesium lines exhibit greater amplitudes than hydrogen lines; calcium and helium lines, smaller amplitudes. These phenomena are difficult to explain. Comparisons with other Be spectra are made in a brief discussion. AUTHOR.

1514. Solution of the Light-Curve of X Trianguli. Virginia Modesitt and T. Martin. *Astrophys. J.* 79. *pp.* 361–364, *April*, 1934.—This solution is based on Jordan's photographic observations. The light-curve shows both ellipticity and reflection effects, a total primary, and uniform brightness of the discs. AUTHORS.

1515. Distribution of Stars in the Catania Zone of the Astrographic Catalogue. L. Taffara. *Accad. Lincei, Atti*, 18. *pp.* 559–566, *Dec.* 17, 1933.—The zone undertaken by Catania, + 46 to + 55°, is nearly completed, and is already used for preliminary studies in statistics. To investigate the distribution of stars in this zone, the number of stars contained in each hour of R.A. has been separately counted: the maximum number occurs between hours 22 and 23, where the zone lies wholly in the Milky Way, and the minimum between hours 11 and 12. A count of 200781 stars between 0° and + 6° made by the late G. Celoria has also been analysed, and this zone is found to have two maxima and two minima, because it crosses the Milky Way at two points. Using in addition to the Catania zone the northern zones of nine other observatories, and comparing the range of stellar densities found at different latitudes, it appears that stellar distribution is approximately homogeneous near the equator, and also towards the north pole, but that it suddenly becomes very unequal at 45° to 65°, with a sharp maximum at 54°. This is due to the richness of the Milky Way in these latitudes at hours 22 to 23, and it confirms the observation of Easton that the Milky Way is much brighter here than in Monoceros, and that therefore the sun is probably nearer to this side of the Milky Way. Extra-galactic condensations are also indicated by secondary maxima in lat. 48° between hours 2 and 3, 6 and 7, and 19 and 20. M. A. E.

See also Abstract 1487.

SUN.

1516. Possible Variations in Intensity of Fraunhofer Lines. M. Minnaert, W. Bleeker and A. P. H. van der Meer. *Zeits. f. Astrophysik*, 8. *pp.* 59–61, *Feb.*, 1934.—The intensities of the lines H and K in the spectrum of general sunlight are measured daily at Utrecht. In a series of spectra taken near sunspot maximum in 1927, there seem to be variations in an irregular period of about 3 days. In two later series, taken in the minimum period 1932, May and December, the variations are not greater than the errors of measurement. A method of control has been devised, which was applied in the last series, and this will give greater certainty at the next sunspot maximum. M. A. E.

See also Abstract 1509.

GEOPHYSICS.

GEODESY.

1517. Elevation of the Geoid in the Alps. K. Mader. *Gerlands Beitr. z. Geophys.* 41. 1. *pp.* 56–85, 1934.—The Alps are treated as consisting of two right-angled triangular prisms meeting at the crest, extending therefrom 77·6 km. to the north and 127·6 km. to the south, at slopes of 1° 51′ and 1° 21′ respectively, with two four-sided rectangular prisms, one under the northern triangular prism the other extending 60 km. north thereof, and both 0·5 km. thick; each extends 300 km. east and west from the centre line runing N–S through the Brenner. The potential at any point in these prisms is calculated and thence the elevation of the geoid deduced at seven points on the N–S centre line on the assumption of (*a*) no compensation, and (*b*) and (*c*) isostatic compensation according to two schemes. These give respectively, as the maximum elevations of the geoid (at the Brenner) 40·1, 11·4 and 13·1 m. The corresponding deviations of the vertical there, and 137·6 km. N. and 127·6 km. S. are + 5·5″, + 0·5″, and + 6·1″; + 34·6″, + 19·9″ and 14·9″; and − 29·0″, − 5·9″ and − 9·3″. C. A. S.

See also Abstract 1497.

GEOPHYSICS, APPLIED.

1518. Field Due to a Cable of Finite Length in Presence of Conducting Plane. S. S. Stefanescu. *Beitr. z. angew. Geophys.* 4. 2. *pp.* 165–185, 1934. *In French.*—The calculation, due to Levi Civita, of the magnetic field due to conducting plane in the presence of a cable of infinite length and carrying a.c. has been applied by Lundberg for structural studies. In practice the condition that the cable must be long compared with the depth of the conducting plane is difficult to realise. The present paper extends the calculation to the case of a cable of finite length lying in a region in which a plane conducting bed occurs. It is assumed that the media above and below the bed are "infinitely resisting," *i.e.*, will allow the current to flow from the cable to the conducting plane, as opposed to the completely insulating properties of the air. The case first considered is the case of an alternating dipole lying in the surface. It is then shown that any conductor lying on the surface can be built up from a number of dipoles, and the resultant field obtained by the superposition of effects. In the case of a straight finite cable, approximations are obtained for the magnetic field at the surface. These results are applied to measurements made in the same area using cables of lengths 1800 m. and 100 m. with good agreement between the values obtained for the depth of the conductor. J. M. B.

1519. Interpretation of Resistivity Curves by Central Induction and Wenner Methods. J. G. Koenigsberger. *Beitr. z. angew. Geophys.* 4. 2. *pp.* 201–216, 1934.—The interpretation of resistivity measurements obtained near Freiburg using both the central induction method [see Abstract 4412 (1933)] and the four-electrode method is discussed. Starting from crude approximations to the depths and resistivities of the various strata taken from the Wenner curve, a series of successive approximations (obtained by trial) are made to fit calculated values for the apparent resistivity to those measured by the central induction method. It is claimed that the interpretation is reduced to 15 hrs. The position of the points of inflection on the J curve (curve of apparent resistivity using the induction method) are investigated theoretically, and it is shown that, as in other methods, these bear no simple relation to the position of the interfaces. Further detail of the apparatus and field procedure are given. The application of the new method in the search for oil and water horizons in desert regions where the surface potential methods are handicapped is considered and the possibility of locating pure water below salt water horizons indicated. A note on the method of electrical oscillations due to Loewy is appended. J. M. B.

HYDROSPHERE, PHYSICS OF THE.

See Abstract 1530.

LAND, PHYSICS OF THE.

1520. Flow of Compressible Fluids Through Porous Media and Some Problems in Heat Conduction. M. Muskat. *Physics*, 5. *pp.* 71–94, *March*, 1934.—In Part I the general partial differential equations are derived for the flow of compressible liquids and of gases through porous media, on the basis of the generalised Darcy law that: for *all* homogeneous fluids the fluid velocity is directly proportional to the pressure gradient. The equation for compressible liquids turns out to be the Fourier heat conduction equation with the density as the dependent variable, while for gases a nonlinear parabolic equation is obtained. The steady state solutions for these equations for linear and plane radial flow are derived and discussed in Part II. The heat conduction equation, in polar coordinates with radial symmetry, for compressible liquids, is then solved in Part III for three given systems. Applications are made to oil wells and reservoirs. The solutions for all these problems correspond to similar heat conduction problems which have not been previously solved explicitly in the literature. In Part IV an approximation theory is given for the non-isothermal gas flow from a closed circular reservoir into a central well. AUTHOR.

See also Abstract 1403.

METEOROLOGY.

1521. Atmospheric Ozone. J. Gauzit. *Comptes Rendus*, 198. *pp.* 492–494. *Jan.* 29, 1934.—The optical density of atmospheric ozone for $\lambda 6100$, as a function of the mass of air traversed (5–35 times the vertical thickness of the atmosphere) was determined by means of the author's spectrophotometer [see Abstract 530 (1933)] during August, 1933, at the Pic du Midi Observatory. The results are explicable on the assumption that the ozone is partly (70–92 %) collected in a thin layer at a height of 18–55 km. (above the Pic), and partly (8–30 %) uniformly diffused throughout the atmosphere. The amount so diffused is equivalent (at normal pressure) to a layer $35–85 \times 10^{-4}$ cm. thick per km. C. A. S.

1522. Scientific Work in the "Century of Progress" Stratosphere Balloon. A. H. Compton. *Nat. Acad. Sci., Proc.* 20. *pp.* 79–81, *Jan.*, 1934.—This note refers to experiments carried out during the flight of November 20, 1933, when a height of 18,665 m. was reached. Four of the eleven sets of experiments refer to cosmic rays. Self-recording instruments measured the ionisation due to these rays. Among the results referred to in the note are those obtained from observations on the polarisation of sky light, colour of the sky, and radio signal transmission. A short description of the balloon and of some of the instruments used is also given. A. E. M. G.

1523. Aerological Investigation of Atmospheric Disturbances with Special Reference to Stratospheric Processes. E. Palmén. *Soc. Scien. Fennica, Comm. Phys. Math.* 7. 6. [65 *pp.*], 1933. *In German.* —Temperature and pressure oscillations caused by thermal advective and dynamical processes are distinguished. The former process includes horizontal advective motion of cold and warm air masses at different heights. The latter includes changes of temperature and pressure under which the general air flow is limited by considerations of the coriolus and centrifugal forces. It is shown that advective processes predominate in the development of a cyclone and temperature changes can be traced to meridional convection. The waves at the tropopause and on the polar front are related at this stage but have a phase displacement. From this scheme conclusions can be drawn regarding air flow at high levels, movements of upper clouds and warm and cold stratospheric outflows. Most important in the study of horizontal advection are the temperature changes across travelling fronts. In Europe these are most marked for polar fronts at 4–7 and 11–13 km. where they have opposite signs. The tropopause height also may change 3–5 km. in one day. With a large longitudinal displacement of the polar front the temperature oscillations are such that the cold air reaches the tropopause and in some cases a similar frontal movement occurs in the lower stratosphere between cold subtropical and warm subpolar air masses. As occlusion of a cyclone begins the temperature and pressure oscillations depend mainly on rotation in the cyclone. A typical deformation field then occurs which alters the tropopause, sometimes breaking and then reforming it at another level. An example of this "leaf" structure of the tropopause is discussed. It is shown that with an occluded deep cyclone there is a sharp inversion at the tropopause as with anticyclones, but it extends only about 1 km., while with the latter it may extend for several km. The vertical motion established at the occurrence of cyclones and anticyclones can be calculated from the distribution of potential temperature and from considerations of radiation and advection, but much aerological data are required for exact values. At cyclogenesis on the arctic front in winter the stratospheric processes probably differ from those on the polar front. It is considered that the seat of atmospheric pressure oscillations can only be found by a more exact analysis of the processes in different levels and by international co-operation in the supply of observations. R. S. R.

1524. China Rainfall and World Weather. Chang-Wang Tu. *Roy. Meteorolog. Soc., Mem.* 4. *pp.* 99–117, *Feb.*, 1934.

1525. Dust and Smoke. R. Whytlaw-Gray. *Roy. Inst., Proc.* 28. *pp.* 149–163, 1933–1934.—The author first draws distinction between dust and smoke particles especially in regard to size, and shows how the movements of the particles are affected by their size. The behaviour of smoke particles on colliding depends largely on the method of producing the particles, differing according as the particles are charged or uncharged. Experiments are described which show (1) that smokes coagulate, and (2) that the coagulation of a smoke can be represented by a simple mathematical formula. This latter enables the number of particles present at any time to be calculated. Reference is made also to the changes in the colour of smoke during coagulation. Passing to the theoretical aspect the author shows that the conclusions on the rate of coagulation which can be drawn from theory are in agreement with experiment if the particles are all of the same size, as in " blown " smokes. He finally concludes that " coagulation apparently occurs at every chance encounter of the particles and is a normal characteristic of aerial systems." Dusts follow the same linear law. A. E. M. G.

1526. Light Scattering and Sky Radiation. H. Steinhäusser. *Gerlands Beitr. z. Geophys.* 41. 1. *pp.* 103–113, 1934.—The author obtains first the relations which hold for the extinction coefficient when different definitions are used and then derives a formula for the distribution of radiation from the sky, with simple scattering, for a barotropic atmosphere whose extinction coefficient is assumed to be proportional to the density. Results obtained formerly by other authors are discussed critically, and in a table results are set out for the ratio of the intensities of scattered light for angles of deviation of 0° and 180°. It is concluded that in consequence of the differences of scattering for particles of different kinds and sizes conclusions cannot yet be drawn from the form of the scattering function, regarding the effect of individual components when these are of different kinds and sizes. R. S. R.

1527. Spectrum of Night Sky at Pic du Midi. J. Cabannes and J. Dufay. *Comptes Rendus*, 198. *pp.* 306–309, *Jan.* 22, 1934.—Using a more sensitive spectrograph, the authors have reduced the exposure necessary to photograph the spectrum of the night sky [see Abstract **3446** (1933)]. A table of **91** lines, **44** new (of which **31** are regarded as certain), is given and analysed. In addition to N and O, He and many A lines are identified. The principal unidentified lines of cometary nuclei are all very near lines measured by the authors. The intensity of the continuous spectrum for different parts of the sky was compared by a reflecting prism ; it was greater for the zenith than for the south horizon, but still greater for the north horizon. The discontinuous spectrum was always greater for horizon than for zenith. The altitude of the luminous regions is estimated at upwards of 100 km. T. L. M.

1528. Objective Visibility Measurement. L. Bergmann. *Phys. Zeits.* 35. *pp.* 177–179, *March* 1, 1934.—Light from a cinema projector lamp of 100 W. is passed through a filter and system of lenses to obtain a parallel beam which is reflected back from a silvered mirror 20 to 40 m. away into a selenium cell [see Abstract **3262** (1933)]. Some of the light from the same source after passing the filter is deflected at right angles into a second cell. The currents from the two cells pass through two primaries of a transformer so as to oppose one another. Then by adjusting a diaphragm in front of the second cell, a measure of the visibility of the air track between the source and the first cell is obtained. By preliminary experiments, it is shown, that the instrument is very sensitive, and that the method may be extensively applied. H. M. B.

1529. Theory of Psychrometer. W. J. Humphreys. *Monthly Weather Rev.* 61. *pp.* 300–302, *Oct.*, 1933.—By considering the construction of the instrument the author shows that in dealing with the wet bulb temperatures registered, it is only necessary to consider the loss of heat through evaporation and the simultaneous gain of heat by contact with the surrounding air. So first he equates the loss of heat in the " steady state " by evaporation of *n* molecules of water to the heat got from N molecules

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of air on cooling. Another relation is found between *n* and N involving the barometric pressure and the pressure *e″* due to the freshly evaporated water. Combining these two relations, the quantity *e″* is found. But this quantity is equal to the difference between the saturation vapour pressure, *e′*, at the temperature of the wet bulb and the vapour pressure of the free air, *e*. Hence by a combination of the above relations, an expression is found for *e*. A. E. M. G.

1530. General Report of the Expedition with the "Maud." H. U. Sverdrup. *Norwegian North Polar Expedition with the "Maud,"* 1918–1925, *Sci. Results*, 1. 1. [22 *pp*.], 1933.

See also Abstracts 1502, 1751.

SEISMOLOGY.

1531. Surface-Reflected Waves of Shallow-Focus Earthquakes. E. A. Hodgson. *Seismological Soc. of America, Bull.* 2. *pp.* 33–46, *Jan.*, 1934.—In seismological tables developed during the first decade of the present century, it was always assumed that the focus lay in the surface. Under such circumstances, the so-called PR_1-wave, the wave once reflected at the surface at a point midway between the focus and the point of observation, would be expected to have a travel-time double that for the compressional or P-wave to the mid-point. Observation failed to support the earlier PR_1-tables, which were constructed from the P-tables on this assumption. It was later found that earthquake foci do not always, nor even generally, lie in the surface. Furthermore, the P-curves for earthquakes known to have shallow foci are now found to differ considerably from the earlier curves based on group data. It became desirable to study the travel-times for the reflected waves from the data of a single well-defined earthquake. The Tango earthquake, Japan, March 7, 1927 [see Abstract 2294 (1933)] furnished the opportunity for such a study, the results of which are presented in this paper. AUTHOR.

1532. Propagation of the Longitudinal Waves of the Long Beach Earthquake. B. Gutenberg. *Gerlands Beitr. z. Geophys.* 41. 1. *pp.* 114–120, 1934. *In English.*—In a table values are given for 72 stations of the distance from the epicentre, travel time of the P_n waves calculated by Jeffreys, and the difference between the observed and calculated times of arrival for the S. California earthquake of 11 March 1933. Within 1 to 2 sec. these times agree. Values are also derived for the apparent velocity of the P_n waves for different distances. Within the limits of error the values up to 15° agree with those found by Gutenberg and Richter for Mexican shocks observed in California. It is concluded that the velocity is nearly constant at $8 \cdot 0 \pm 0 \cdot 1$ km./sec. in the upper part of the sima (depths below 40 km.), but it begins to increase at a depth somewhat below 100 km. There is no indication of a discontinuity in the mantle of the earth at larger depths and especially none at 300 km. and none corresponding to an epicentral distance of 20°. Since the travel times agree also with those for Japanese earthquakes they are true regardless of the position of the epicentre within very small limits but they depend noticeably on the depth of focus. R. S. R.

1533. Water Pressure in a Tank Caused by a Simulated Earthquake. L. M. Hoskins and L. S. Jacobsen. *Seismological Soc. of America, Bull.* 24. *pp.* 1–32, *Jan.*, 1934.—Motion was imparted to a shaking table by the elastic impact of a pendulum moving with known velocity, acting against a spring-bumper on the table. The tank of water was

supported on the table and one support provided with a dynamometer. The pressures obtained agreed reasonably with the theory of Westergaard.
W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1534. Mobility-Spectrum of Atmospheric Ions. H. Israël and L. Schulz. *Terr. Mag.* 38. *pp.* 285–300, *Dec.*, 1933.—The methods of determining the "ionic spectrum," that is, the percentage-distribution of the ions for different mobilities, are discussed. Three different methods are described and their "resolving-power" is discussed: the double-condenser method, the method of the subdivided condenser, and the analysis according to Benndorf. The ionic spectra as determined to date at twelve different stations are assembled. Since the resolving-power of the double-condenser method is limited, only four rather large mobility-regions are at present differentiated. Apart from very large local differences, which cannot yet be cleared up individually, there appears an annual variation in the composition of the spectra, such that the spectral centre of gravity lies at the smaller mobilities in winter and at the larger in summer. Increase of humidity has obviously the effect of enlarging the ions or of diminishing their mobility through the accretion of water-vapour by them. A consideration of the separate representative mobilities of the various spectra shows that these are related as 1 : 2 : 3 or 1 : 2 :4. This simple relationship suggests that perhaps the ions are of equal size but with one, two, or more elementary charges. AUTHORS.

1535. Electrical Rectification by the Lower Atmosphere. R. Gunn. *Terr. Mag.* 38. *pp.* 303–308, *Dec.*, 1933.—The relation of the current-density to the impressed electric field-intensity is worked out for the atmosphere, taking account of space-charge. It is shown that the departures from Ohm's law are such that electricity is transferred outward from the earth with greater ease than inward. Thus the large random alternating electric fields of the type observed during storms will result in a net upward transfer of electricity, which may leak off over a large area and contribute to the normal or fair-weather electric field. The fair-weather field is downward and hence, with given field-intensities, the electrical discharge of the earth is more difficult than is the process of replenishment. The fundamental action of the atmosphere as an electrical rectifier is emphasised. AUTHOR.

1536. Atmospheric Electric Observations. A. R. Hogg. *Gerlands Beitr. z. Geophys.* 41. 4. *pp.* 1–31, 1934. *In English.*—Results of atmospheric electric observations at the Commonwealth Solar Observatory, Canberra, show: (1) A diurnal maximum of potential gradient three to four hours later in universal time than the maximum over the oceans ("Carnegie" observations). (2) A diurnal maximum of air-earth current simultaneous with the maximum over the oceans. (3) A local variation of conductivity accounts for the difference in time of maximum gradient at the observatory and over the oceans. (4) Changes of the rate of ionisation and nucleus concentration determine the daily march of the conductivity. (5) A diurnal maximum of the rate of ionisation at about the same universal time as that at Glencree and Washington. (6) Various relationships between conductivity, nuclei, intermediate ions, small ions, etc., and meteorological phenomena. (7) The intermediate ions carry unit electronic charges. (8) The ratio of the numbers of intermediate and large ions varies with the meteorological conditions. AUTHOR.

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1537. Average Life of Small Ions and Atmospheric Ionisation Equilibria. A. R. Hogg. *Gerlands Beitr. z. Geophys.* 41. 1. *pp.* 32–55, 1934. *In English.*—The life of a small ion is deduced as $\theta_+=1/\beta_+=V/4\pi Ck_+H_+$, where V is the volume of the vessel, C the capacity of the exposed portion of the inner electrode, k_+ the mobility of the positive small ions in the vessel, H_+ the potential for which the current is half the saturation current, and β_+ the diminution constant for positive ions, with a similar equation for θ_- and β_-. The life so deduced is $k_+/(k_++k_-)$ times the value given by Schweidler's Method II, and its use removes the discrepancy between his two Methods. The non-proportionality of β to the concentration of nuclei is due to doubly charged large ions. From 100 sets of observations near Canberra (Australia) the maximum, minimum and average values of $\bar{\theta}[=(\theta_++\theta_-)/_2]$, $\bar{\beta}[=(\beta_++\beta_-)/_2]$, and the mean rates of production of positive and negative ions, q_+, q_- are 69·6, 7·2, 38·1; 144·0, 14·6, $30\cdot2\times10^{-3}$; and $13\cdot7_1$ and $13\cdot7_4$ respectively. The relations between these quantities and meteorological conditions are discussed.

C. A. S.

1538. Electric Conductivity of the Lower Atmosphere Due to Ultra-Radiation. E. Lenz. *Hochfrequenztechn. u. Elektroakustik*, 43. *pp.* 47–51, *Feb.*, 1934.—From the ultra-radiation intensity measurements of Regener [see Abstract 2988 (1933)] calculations are made of the ionising power of the ultra-radiation and of the ion content and electric conductivity of the lower atmosphere. The ionising power of the ultra-radiation is found to be 12 I/cm.^{3} sec., the ion content 10^4 I/cm.^{3} and the conductivity 50×10^{-12} ohm^{-1} cm^{-1}, the ionising power having a maximum value of 45 I/cm.^{3} sec. at a height of 13 km. I denotes an ion pair. It thus appears that besides the Kennelly-Heaviside layers with maximum ion content at about 100 km. height another layer exists, much nearer the earth, due to ultra-radiation. The essential difference between these two lies in the fact that the ultra-radiation layer contains at most 10^4 ion pairs per cm.^{3}, while the Heaviside layer contains about 10^4 free electrons per cm^3. In consequence the ultra-radiation layer can have no effect on the propagation of short radio waves, though it may possibly affect that of long waves. A. W.

1539. Auroræ, Electric Echoes and Magnetic Storms. J. Larmor. *Nature*, 133. *pp.* 221–223, *Feb.* 10, 1934.—Reference is made to the results obtained by Appleton and others regarding the complex connections between the optical and magnetic phenomena of the upper atmosphere, and consideration is given to electron densities required in the reflecting layer to provide reflection by rays following vertical or oblique paths. A scheme is next introduced in which it is assumed that the aurora is due to lasting local pulsations on a large scale, of long period, excited by a local cause, large enough and of abrupt type, produced conceivably by arrest high up of an ionised torrent from outside sufficiently concentrated to require relief by propagation in waves. This could give the banded auroral curtains with spiralling transmission along the magnetic field. The splitting by the earth's magnetic field of the radiation into two cyclic components is examined for magnetic fields along and transverse to the waves and the methods by which these components could be verified. Finally, the effects of Hamiltonian group velocity and transitions between energy levels are discussed. R. S. R.

See also Abstracts 1530, 1733.

RADIOACTIVITY.

1540. Radioactivity of Neodymium, Samarium and their Mixtures. L. Rolla and L. Mazza. *Accad. Lincei, Atti*, 18. *pp.* 472–478, *Dec.* 3, 1933.—All fractions of Sm_2O_3 separated from a large sample of commercial didymium showed somewhat different radioactivities. Purification by means of barium and lead removes to some extent substances of extraneous radioactivities, but does not entirely eliminate the differences. Neodymium shows very slight radioactivity, due probably to extraneous matter, which partly disappears during purification. Praseodymium shows absolutely no radioactivity. The existence of a radioactive element 61 is regarded as somewhat uncertain, unless the small variations in activity found in the different specimens of samarium and the very faint activity of neodymium are to be attributed to this element. T. H. P.

1541. Emission of Corpuscular Rays (β-Rays and Positrons) and the Symmetry between Corpuscles and Anti-Corpuscles. J. L. Destouches. *Comptes Rendus*, 198. *pp.* 467–469, *Jan.* 29, 1934.—Fermi's theory of the emission of β-rays, based upon the analogy of such emission with that of a photon is shown to be derivable from wave mechanics. The internal coordinate, ρ, of Fermi's theory is considered as an index. It appears more natural to discuss the electron and positron symmetrically, rather than asymmetrically, as in Dirac's theory. J. S. G. T.

1542. Representation of Nuclear Transformations. G. Petiau. *Comptes Rendus*, 198. *pp.* 564–566, *Feb.* 5, 1934.—In view of the complications consequent upon the number of elementary particles which are now hypothesised and which might all find their place in a nucleus, two alternative simplifications are proposed. These are based upon a series of hypothetical transformations such as the disintegration of a proton into a neutron, positron and an antineutrino. It is claimed that such a hypothesis provides an explanation of natural β- and γ-ray activity J. E. R. C.

1543. Radioactivity of Air. H. Garrigue. *Comptes Rendus*, 198. *pp.* 494–496, *Jan.* 29, 1934.—Comparative observations of the conductivity of the air on the Pic du Midi (2860 m.) show that the spontaneous ionisation due to radioactivity of the radon type is approximately 1000 times greater when the Pic is under snow than in summer, when it is of the order of 7 ions/cm.^{3}/sec. C. A. S.

1544. Actinium-Uranium Bifurcation Ratio. M. Francis and Tcheng Da-Tchang. *Comptes Rendus*, 198. *pp.* 733–735, *Feb.* 19, 1934. —The uranium and protoactinium were separated from three samples of Belgian Congo pitchblende and one of Colorado carnotite. The thin layers were prepared by crushing in the usual way; by ultrasonic pulverisation; and (for uranium only) by electrolysis of aq. $UO_2(NO_3)_2$ at 60° in presence of acetic acid and ammonium acetate and conversion of the resultant hydrate to U_3O_8 at 700°. The ratio of the ionisation currents averaged 0·023 with good agreement between individual measurements; this gives a bifurcation ratio of 4. C. A. S.

1545. Effects of α-Particles on Aqueous Solutions. C. E. Nurnberger. *J. Phys. Chem.* 38. *pp.* 47–69, *Jan.*, 1934.—A direct and an indirect method of irradiating liquids with α-rays from radon is described, and the errors and their correction in the direct method are discussed. The decomposition of water by α-rays is suggested as a method for determining the transmission of α-ray bulbs. The gas yields are shown to deviate somewhat, owing to recombination of ions in the water, from the general law of Cameron and Ramsay. Aqueous solutions of ferrous sulphate were irradiated by both methods, and the gas yield was nearly 100 % hydrogen ; equilibrium lies almost entirely on the side of oxidation of the ferrous to ferric ions. The proportion of ferrous sulphate changed to radon destroyed increases with increase of concentration of the ferrous sulphate up to 0'5 molar. There is evidence of reactions other than the oxidation of the ferrous ions by the decomposition products of water. Dissolved oxygen alone does not account for the yield of oxidised ferrous sulphate. N. M. B.

1546. Chemical Separation of New Radioactive Elements. Irène Curie and F. Joliot. *Comptes Rendus*, 198. *pp.* 559–561, *Feb.* 5, 1934.—The authors have shown previously [see Abstract 1069 (1934)] that bombardment of B, Al and Mg with α-particles produces in each case a new radioactive element. They now describe chemical processes by which these elements can be separated and which indicate that these elements are isotopes of N, P, and Si, *viz.*, $^{13}_{7}$N, $^{30}_{15}$P and $^{27}_{14}$Si. It is proposed that these elements should be termed radioazote, radiophosphore and radiosilicium. J. E. R. C.

1547. Theory of β-Rays. E. Fermi. *N. Cimento*, 11. *pp.* 1–19, *Jan.*, 1934. *Zeits. f. Physik*, 88. 3–4. *pp.* 61–171, *March* 19, 1934.—A quantitative theory of the emission of β-rays is explained. This admits the existence of the "neutrino," a new particle proposed by Pauli having no electric charge and mass of the order of magnitude of that of the electron or less. The emission of the electrons and of the neutrinoes from a nucleus on the occasion of the β-disintegration is treated by a method similar to that followed in the theory of radiation to describe the emission of a quantum of light from an excited atom. Formulæ are deduced for the mean life and for the form of the continuous spectrum of the β-rays and these are compared with experimental data. J. J. S.

1548. Temporary β-γ Coloration of Sodium Disilicate Glasses and Causes of Violet Colour in Manganese Glasses. J. Hoffmann. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 9–10. *pp.* 437–444, 1934.—The violet colour induced by radiation in Na_2O, $2SiO_2$ glasses is due to carbonate and the yellow colour to sodium–iron oxygen compounds. The yellow colour appearing in the molten state is due to traces of Pt too small to be detected chemically. J. E.

1549. Ionisation in Nitrogen at High Pressures. S. Chylinski. *Phys. Rev.* 45. *pp.* 309–313, *March* 1, 1934.—The ionisation-pressure relation in nitrogen has been studied at various pressures up to about 120 atmospheres. This was done for both γ- and residual- (= local + wall + cosmic radiations) rays with and without a lead shield. The resulting curves seem to have identical forms. The ratios of γ- to residual-ionisations are constant for pressures down to about 20 atmospheres, decreasing rapidly for lower pressures. A series of saturation characteristics of nitrogen at various high pressures (up to about 109 atmospheres) and intensities ranging from about 7 to 1200 ions per cc. per sec. per atmosphere were also determined experimentally. These characteristics do not have identical forms, *i.e.*, they cannot be made to coincide if multiplied by constant factors. AUTHOR.

See also Abstracts 1380, 1683, 1684, 1718, 1752.

RADIATION.

ABSORPTION AND TRANSMISSION.

1550. Light Absorption in Metals. A. Smakula. *Zeits. f. Physik,* 88. 1–2. *pp.* 114–126, *Feb.* 21, 1934.—Extending his previous work [see Abstract 142 (1934)] the author investigates the absorption of seven further metals, namely, Al, Pb, Sn, Cr, Mr, Sb and Bi by a photoelectric method in the region between 7000 to 1860 Å. By introducing the molar absorption constant he obtains a relationship between the absorption and the chemical behaviour of the metals. The number of free electrons is estimated from the height of the corresponding point on the absorption curve. As in the case of Cu, Ag and Au no absorption maxima occur which are simply related to the atomic conductivity.

H. L. B.

See also Abstracts 1567, 1581, 1665, 1666.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

See Abstracts 1416, 1666.

FLUORESCENCE AND PHOSPHORESCENCE.

LUMINESCENCE AND AFTERGLOW.

1551. Phosphorescence in Electrically Excited Mercury Vapour. K. Narkiewitz-Jodko. *Acta Physica Polonica,* 2. 3. *pp.* 311–333, 1933. *In German.*—In the photoluminescence of Hg vapour there are, besides the arc lines, a number of continuous bands of phosphorescence. These may be due either to absorption of the Hg resonance line 2537 Å or to molecular absorption of ultra-violet bands. A metastable state is indicated by the duration (10^{-3} sec.). Since a pressure increase, either by Hg itself or some foreign gas, leads to a simultaneous increase of brightness and shortening of decay time, collisions must play a part. The aim of this work was to find what happens to the excitation energy and what is the rôle of the Hg ions found in electrical excitation. The author first considers the kinetics of energy transfer, coming to the conclusion that a minimum pressure is necessary depending on the effective cross-section of the atom or molecule and the mean life of the excited state. An apparatus is described for electrically exciting a moving stream of Hg vapour and for determining the velocity of transference of the phosphorescence behind the anode and kathode, the minimum pressure for phosphorescence, the connection between pressure and range of phosphorescence. Another apparatus is described for determining the function of the ions formed. The author concludes from his observations that there are two types of phosphorescence in electrical excitation: (1) behind the anode—similar to optically excited phosphorescence. This is probably due to transition from metastable atoms and molecules. (2) Behind the kathode. In this four parallel processes are surmised, (*a*) passing on of ionisation by collision, (*b*) passing on of excitation by collision, (*c*) recombination of ions, and (*d*) emission of light.

J. E.

1552. Crystal Luminescence of NaCl. W. D. Kustnetzow and W. E. Kotler. *Phys. Zeits. d. Sowjetunion,* 5. 1. *pp.* 40–56, 1934. *In German.*—During the crystallisation of NaCl from a saturated solution by addition of HCl solution light is given out. Observations on a number of mixtures of different volumes of each reagent lead to the conclusion that the crystal luminescence is intimately related to the triboluminescence that is to the deformation of the crystal lattice. It is found that the most intense light is given by a mixture of 16 c.c. of NaCl, saturated solution, to 14 c.c. of HCl (23 %) and that this corresponds to the minimum rate of crystallisation and to the most perfect crystals. The light emission begins at the moment of formation of the crystals. J. E.

1553. Influence of the Solvent on Fluorescent Power of Dyestuffs. J. Bouchard. *Comptes Rendus*, 198. *pp.* 649–651, *Feb.* 12, 1934.—The law of F. Perrin $\phi = \phi_0 e^{-kc}$ was confirmed up to fairly high concentrations, *c*, for constant values of pH. It is found that the limiting fluorescing power is independent of the solvent as long as there is no inhibitor and that the coefficient *k* depends on the solvent, according to the relation $k = 1/(A - B.\epsilon)$, where ϵ is the dielectric constant of the solvent. This is not true when the viscosity differs appreciably from that of water. Further, the fluorescent power when the solution contains an inhibitor is given by $\phi = \phi_0 e^{-(kc+ns)}$ where *s* is the concentration of the inhibitor. J. E.

1554. Degree of Polarisation of the Fluorescence of Pure Mercury Vapour. A. Kastler. *Comptes Rendus*, 198. *pp.* 723–725, *Feb.* 19, 1934.—The polarisation of the fluorescence lines of mercury at 4046, 4358 and 5461 Å diminishes in the order named and falls considerably with rise of temperature. Calculations of the degree of polarisation under different conditions of incident radiation are given. **Errata,** *ibid*, *p*. 860, *Feb*. 26, 1934. H. F. G.

See also Abstracts 1567, 1620.

INTERFERENCE. DIFFRACTION AND SCATTERING.

1555. Negative Result of an Attempt to Combine Light Quanta. C. J. Gorter. *Physica*, 1. *pp*. 199–200, *Jan.*, 1934. *In English.*—An attempt has been made to detect the combination of two small light quanta to form one of larger energy. Sunlight from which all blue, violet and ultra-violet wave-lengths had been filtered off was concentrated into a liquid (water or aqueous $NiCl_2$), a density of 10^9 photons per $cm.^3$ between 5000 and 6000 Å being obtained. The light scattered sideways was photographed in a large-aperture quartz spectrograph on plates which were insensitive to the green and yellow. With exposures up to 50 hours, no blue or ultra-violet scattering was observed, although with a density of 10^9 photons per $cm.^3$, a positive result should have been obtained for one combination per cm. path in 10^{12} photons. The "effective area" of a photon must be less than 10^{-5} $Å^2$. C. B. A.

1556. Molecular Diffusion of Light in Liquids. E. Canals, (Miss) G. Cauquil and P. Peyrot. *Comptes Rendus*, 198. *pp*. 471–473, *Jan*. 29, 1934.—The degree of depolarisation ρ of light scattered at 90° in organic liquids is determined by a photographic method using a mercury lamp as source. A table of results (accurate to about 2 %) is given for 37 liquids, comprising mostly saturated and unsaturated cyclic hydrocarbons and their substituted alkyl derivatives, but including some halogen and other derivatives of open chain hydrocarbons. The following general observations are made. In the saturated cyclic hydrocarbons, unlike the

open chain compounds, the value of ρ does not increase progressively with increase of the number n of carbon atoms. In the unsaturated cyclic hydrocarbons no simple relation is found between ρ and n. The presence of a double bond increases the value of ρ. Introduction of an alkyl group into a saturated cyclic hydrocarbon causes an increase of ρ; but in the case of an unsaturated cyclic hydrocarbon the effect depends upon the position of substitution relative to the double bond. Amongst the di-alkyl derivatives of cyclohexane the para-compound has a higher value of ρ than the ortho- or meta-. For derivatives of the same open chain alcohol, the values of ρ increase in the order Cl, Br, NO_2, NO_3.
L. A. W.

1557. Light Scattering and Molecular Polymorphism. R. Lucas. *Comptes Rendus*, 198. *pp.* 721–722, *Feb.* 19, 1934.—The property of polymorphism which is exhibited by certain organic molecules (*e.g.*, tartaric and succinic derivatives, and derivatives of camphor) and which is evidenced by their rotatory power, absorption spectrum, and electric and magnetic birefringence, is shown to affect the scattering of light by them also. In particular, the amount of scattering should be greater than that normally expected, whilst the Raman spectrum should be richer in lines than that for a single type of molecule. The data available for benzene are discussed and shown to support the hypothesis that molecular polymorphism exists in this liquid. C. B. A.

See also Abstracts 1384, 1526, 1563, 1569, 1570, 1571, 1582, 1584, 1664.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1558. Photochemical Union of Hydrogen and Chlorine. Part III. J. B. Bateman and A. J. Allmand. *Chem. Soc., J. pp.* 157–161, *Feb.*, 1934.—In Part II [see Abstract 1719 (1931)] Allmand and Beesley described experiments which led them to the conclusions (*i*) that the quantum yield of the reaction reaches a maximum in the violet, and falls off at both longer and shorter wave-lengths, particularly at the latter, and (*ii*) that the reaction is definitely sensitive to light of wave-length 546μμ (the mercury green line). The present work has resulted in the following data: (1) The rate of photochemical union of hydrogen and chlorine in monochromatic light of wave-length 313μμ was proportional to the intensity. (2) The quantum yield was independent of wave-length between 400 and 490μμ. (3) The quantum yield was of the same order as in (2) between 400 and 290μμ; it appeared to fall off by 10–20 % when passing from the visible to the ultra-violet region. (4) The quantum yield gradually fell off when passing from 490μμ to longer wave-lengths. A definite reaction was found in the region of 540–550μμ. (5) Anomalous observations were made when using monochromatic mercury lamp radiation of 492μμ.
H. H. Ho.

1559. Metol-Hydroquinone Developers. W. Reinders and M. C. F. Beukers. *Phot. J.* 74. *pp.* 78–82; *Disc.*, 82, *Feb.*, 1934.—Examines the influence of the proportion of the mixture, and of the *p*H-value, of metol-hydroquinone developers. Three solutions were made, one containing metol, and another containing hydroquinone, the solutions being arranged so that they could all be brought to the same *p*H-value by the addition of NaOH. Solutions containing either various proportions of metol to hydroquinone or various concentrations of metol alone, or hydroquinone, were obtained by suitably mixing two of the three stock solutions.

The results obtained show that metol alone works as a rather powerful developer at *p*H-values at which hydroquinone alone does not show any effect of reduction, development with metol being possible at $pH=6$, but for hydroquinone the *p*H-value requires to be above 9. The velocity of development, however, increases rapidly with increase of *p*H-value for hydroquinone, this acceleration being far less when using metol. In developers with so low a *p*H-value that hydroquinone by itself gives no, or almost no, effect, the addition of metol improves the developing power considerably. The influence of hydroquinone is still very trifling at $pH=8\cdot99$, but its influence increases with increasing alkilinity, the best proportion of the mixture being given as 1 of metol to 3 of hydroquinone by weight. R. C. F.

1560. Villard Effect. H. Arens. *Zeits. f. wiss. Phot.* 32. *pp.* 233–238, *Feb.*, 1934.—Comparison between the blackening effect to Agfa-Laue film exposed or not exposed to preliminary illumination of various durations with X-rays. A conclusion reached, that there must be a Villard effect with white light as well as with X-rays: a conclusion verified by experiment. [See Abstract 103 (1932).] A. D.

1561. Quantum Theory of the Latent Photographic Image. T. H. James. *J. Chem. Phys.* 2. *pp.* 132–135, *March*, 1934.—An explanation of the process of photographic exposure on the basis of a true photochemical reaction is offered. It is pointed out that the apparent failure of the Einstein equivalence law in the case of photographic exposure for short intervals is not real, and an equation is derived on the basis of the assumption that the *absorption* of one quantum by a sensitivity centre of the grain produces an activated, but unstable state which renders the grain as a whole developable. The assumption that an activated grain may revert to an undevelopable state is an important part of the present theory, and evidence in favour of this assumption is cited. The theory that the photographic process is autocatalytic is criticised on the basis that the point of inflection of the H. and D. curve indicated by this theory is much higher than the point found experimentally. A preliminary treatment of the Herschel effect is given on the basis of the proposed theory, and an equation holding under special conditions is derived. The explanation of the intermittency effect as put forward by Blair and Hylan is still valid in the light of the present theory. Data taken from reliable sources are given to show that the general equation holds over wave-lengths ranging from red light to X-rays, and emulsions from Azo to Eastman Portrait. AUTHOR.

1562. Rapid Photochronograph. A. Magnan and C. Magnan. *Comptes Rendus,* 198. *pp.* 635–637, *Feb.* 12, 1934.—Describes a simple form of photochronograph consisting of a duralumin wheel of 1 m. dia. which carries on its periphery a strip of photographic film covered with a metal band in which are a number of openings so that, in effect, the wheel carries a large number of separate pieces of film which are exposed one by one as the wheel rotates behind a window covered with a fine horizontal slit. A shutter is placed between the objective and the slit so that the slit is only opened for the period during which the wheel completes one revolution. In the model described, the wheel rotates at about 50 r.p s. while the number of units of film on the periphery of the wheel is 600. It is proposed to get up to a maximum rate of 180,000 pictures per second by using higher speeds of rotation and smaller units of film (1·7 mm, high). J. W. T. W.

See also Abstracts 1583, 1599, 1600, 1608.

PHOTOMETRY.

1563. Probable Distribution of Vibration Vector on Illuminated Plane. P. H. van Cittert. *Physica,* 1. *pp.* 201–210, *Jan.,* 1934. *In German.*—A mathematical treatment of the problem of determining the probable distribution of the vibration vector on a plane illuminated by a light source either directly or through a lens. It is shown that the distribution is the same in both cases and that it only depends on the solid angle of the cone of light which reaches each point in the illuminated plane. J. W. T. W.

1564. Yellow-Blue Ratio and Personal Errors in Heterochromatic Photometry. W. S. Stiles. *Phil. Mag.* 17. *pp.* 660–668, *March,* 1934.—An approximate formula is derived which gives the personal error when matching brightnesses of different colour-temperature, in terms of the yellow-blue ratio of the observer. The formula gives results in satisfactory agreement with the errors computed using the complete visibility curves, and also with the errors observed directly. AUTHOR.

1565. Simple Microphotometer. H. v. Oehmcke. *Zeits. f. techn. Physik,* 15. 2. *pp.* 72–74, 1934.—An image of the spectrum plate is thrown upon a white screen; a slit is cut in the screen and a photoelectric cell of the rectifier type mounted behind it. Selection of the line to be measured is then easy. Details of the construction of a laboratory set-up on these lines are given. D. H. F.

1566. Use of Vacuum Photocells for the Comparison of Weak Illuminations. L. Capdecomme. *Comptes Rendus,* 198. *pp.* 462–464, *Jan.* 29, 1934.—It is shown that a vacuum photocell with cæsium kathode (Philips 3512) is suitable for the measurement of illuminations less than 1/100 lumen if a sufficiently high voltage (greater than 150) is applied. A curious effect was observed with cells of this type: when the voltage was raised by steps there was a sudden rise of current in the neighbourhood of 80 volts; further, when the voltage was then reduced by the same steps, the current values were higher than those observed for the same voltages while the voltage was being raised. D. H. F.

1567. Photoelectric Spectrophotometer for Absorption and Fluorescence Measurements. F. P. Zscheile, Jr., T. R. Hogness and T. F. Young. *J. Phys. Chem.* 38. *pp.* 1–11, *Jan.,* 1934.—Measurements are made using a photoelectric cell with a Dolezalek or Compton electrometer and a high resistance leak (solution of iodine in benzene). A current sensitivity of $2 \cdot 2 \times 10^{-17}$ ampere per mm. is obtainable. Using a tungsten filament lamp as source, the slit widths used on the monochromator are such as to isolate spectral regions varying in width from about 3 Å at 4000 Å to 13 Å at 7000 Å. Figures for the reproducibility and precision of absorption measurements are given. The use of the apparatus for fluorescence measurements is also described. D. H. F.

1568. Analysis of Solutions of Chlorophylls-A and -B by Absorption Spectrophotometry. F. P. Zscheile, Jr. *J. Phys. Chem.* 38. *pp.* 95–102, *Jan.,* 1934.—A method is described of determining the composition of a mixture of chlorophyll-a and -b by measuring absorption coefficients with a photoelectric spectrophotometer described elsewhere [see preceding Abstract]. From a measurement at 4400 Å, where the two components have the same absorption, the total chlorophyll (a+b) can be calculated; a measurement at 4100 Å or 4270 Å gives the ratio a : b. The experimental details for obtaining high accuracy are discussed;

an accuracy of 1 % is claimed. A supplementary method which is accurate to 5 % is described. D. H. F.

1569. Gratings for Photographic Spectrophotometry. R. Landwehr. *Zeits. f. Physik*, 87. 7–8. *pp*. 447–459, *Jan*. 26, 1934.—The production of grating copies is discussed and their properties are investigated with particular reference to the progression of intensity of the diffraction phenomena which they provide. A progressive dependence of intensity on wave-length is found and even a direct reversal of the theoretical intensity course. A direct contact copy of a glass grating which is applicable up to 2500 Å is relatively free from the above-mentioned dependence. Contrary to expectation a transparent gelatin grating shows the closest approximation to theoretical requirements. A relation is obtained connecting the distance apart of the diffracted images with the focal length of the camera objective of the spectrograph. The grating constant can be determined from this relation. J. E. K.

See also Abstracts 1528, 1600.

POLARISATION.

1570. Polarisation by Diffraction at a Distance from a Steel Straight Edge. J. Savornin. *Comptes Rendus*, 198. *pp*. 647–649, *Feb*. 12, 1934.—When plane polarised light falls on the edge of a metal plate the components parallel and perpendicular to the edge are diffracted unequally. If the ratio in the incident light is unity the ratio in the diffracted beams is A perp./A parallel = σ/π, which depends on the angle of deviation. The results obtained by the present work using a Gibbs safety razor blade are nearly in accord with Sommerfeld theory and argue in favour of the modification suggested by Raman and Krishnan for a perfectly reflecting edge. J. E.

1571. Polarisation of the Rayleigh Scattering of Light in Crystals. F. Matossi. *Phys. Zeits*. 35. *pp*. 148–149, *Feb*. 15, 1934.—The existence of molecular scattering of light in quartz and rock-salt has already been shown by Landsberg and Mandelstam [see Abstract 1936 (1932)], although little is known of the phenomenon. The present work has been undertaken particularly to investigate the depolarisation angle ρ of the scattered light which is found to depend on the orientation of the crystal. For the case of scattering in gases there is an upper limit of 0·5 to the value of ρ owing to the random distribution of the molecules, but this does not hold for crystals, owing to their regular structure, *e.g.*, for topaz and beryl values greater than 1 have been observed depending very strongly on the orientation. The experiments consisted in observing the scattered light both photographically and photometrically for quartz and Iceland spar for different orientations of the crystals, and tables are given comparing theoretical and experimental values. R. L.

See also Abstracts 1554, 1556.

RADIATION, EMISSION.

1572. Determination of Radiation Constants. W. Koch. *Zeits. f. techn. Physik*, 15. 2. *pp*. 80–83, 1934.—An improvement of Massow's method [see Abstract 3813 (1932)] for the measurement of radiation constants of various materials is described. The surface to be examined is kept at room-temperature while a second surface heated to 100° C. is brought into a stationary state of interchange of radiation with the first.

The quantity of heat which passes through that at the higher temperature is then a measure of the constant of the surface at the lower temperature. The apparatus is calibrated by various aluminium plates, plain, blackened in stripes of different widths and entirely black, for which the radiation constants are already known. The results are in good agreement with those by other methods. H. M. B.

1573. Radiation from the Inside of a Circular Cylinder. Part III. H. Buckley. *Phil. Mag.* 17. *pp.* 576–581, *March,* 1934.—In continuation of previous work [see Abstract 225 (1929)], the author derives expressions for the radiation inside a circular cylinder closed at one end, using a single exponential term to approximate to the kernel of the solution. The results are similar to those found by Yamauti, but cover a wider range of cylinder lengths, and indicate that, assuming the emissivity of tungsten to be 0·30, the length of cylinder required to give within 1 % of full radiation is about 8 times the radius. Yamauti's three-term approximation gives l/r = about 9·5. J. S. G. T.

1574. Reflection and Refraction of Harmonic Electromagnetic Waves of Any Form at a Plane Surface. G. A. Maggi. *Accad. Lincei, Atti,* 18. *pp.* 335–341, *Nov.* 5, 1933.—If harmonic electromagnetic waves of any form are incident upon a plane surface which separates two media, the equations of the electromagnetic field and the conditions to be satisfied at the boundary are not in themselves sufficient to determine uniquely the reflected and refracted waves, except in the special case where the waves are ordinary plane harmonic waves. The paper suggests certain additional equations which would make the solution determinate. A. J. McC.

1575. Refractive Index of Water for λλ 3–3·6 Metres. M. M. Alimowa and N. S. Nowosilzew. *Ann. d. Physik,* 19. 1. *pp.* 118–120, *Jan.,* 1934.—Undamped waves were used as formerly employed by one author [see Abstract 1598 (1930)]. Comparing the results with previous measurements, no dispersion was found in the region λλ 2·2–3·6 m. F. S.

1576. Electromagnetic Waves of 1·1 cm. Wave-Length and the Absorption Spectrum of Ammonia. C. E. Cleeton and N. H. Williams. *Phys. Rev.* 45. *pp.* 234–237, *Feb.* 15, 1934.—A spectrometer, with a grating of the echelette type, was used in mapping the absorption spectrum of ammonia gas in the region from 1 to 4 cm. wave-length. To accomplish this, it became necessary to produce electromagnetic waves of shorter wave-length than had been produced before by valves. Oscillators of the magnetron type were used as the source of the continuous short wave radiation. The centre of the absorption band had been predicted to be at 1·5 cm. wave-length. The maximum absorption was found to occur at 1·25 cm. This shift is explained by the unsymmetrical nature of the line. The constants in a theoretical formula for the absorption coefficient have been determined. These constants involve an effective collision diameter of the molecule, and lead to the value $\sigma = 8 \cdot 8 \times 10^{-8}$ cm. The total intensity of the lines was found to be 10×10^{7} cm.$^{-1}$ sec.$^{-1}$. AUTHORS.

1577. Absorption of Cosmic Radiation. T. H. Johnson. *Frank. Inst., J.* 217. *pp.* 167–171, *Feb.,* 1934.—This paper discusses briefly present knowledge of the absorption of cosmic radiation as determined by intensity measurements at various heights in the atmosphere and depths below the surface of lakes. It is now agreed that the radiation must consist of several components of different penetrating power. The schools represented by Millikan and Regener assume different mechanisms for the absorption processes; nevertheless, the calculated absorption coefficients agree quite closely in the two cases. The possibility of these radiations being due to annihilation processes is mentioned. It is considered that useful information will be obtained by making use of the energy selection provided by the earth's magnetic field at different latitudes, and by cloud chamber experiments. D. H. F.

1578. Oscillation of Cosmic Radiation. Part III. W. Messerschmidt. *Zeits. f. Physik,* 87. 11–12. *pp.* 800–805, *Feb.* 19, 1934.—An ionisation chamber was arranged at a height of 33 m. above the earth's surface with a lead shield opened at the side which was rotated hourly through 90°. An excess of radiation entering from the west was found. Its magnitude amounted to about 3‰ with an accuracy of measurement of ± 0·2 ‰. The maximum of the excess radiation is situated at a zenith distance of about 45°. The measurements give further information on the solar time period of the unfiltered cosmic radiation. With level entrance of radiation the emanation content of the layers of air near the earth is made noticeable. [See Abstract 4900 (1933)]. J. J. S.

See also Abstracts 1484, 1522, 1538, 1539, 1549, 1742.

RADIATION, GENERAL THEORY.

1579. Field of Force of an Elementary Particle. G. Wentzel. *Zeits. f. Physik,* 87. 11–12. *pp.* 726–733, *Feb.* 19, 1934.—In an earlier paper [see Abstract 625 (1934)] the author has shown that, based upon certain definitions, the electromagnetic mass of an elementary particle is zero. In the present paper new definitions for the energy and momentum of an electromagnetic field are proposed. On this basis the methods of quantum mechanics lead to the result that the field of an elementary particle in uniform motion has zero energy and momentum. J. E. R. C.

See also Abstracts 1459, 1460, 1555.

REFLECTION. REFRACTION AND DISPERSION.

1580. Anomalous Dispersion in the H-K Doublet of Ionised Calcium. L. Puccianti. *N. Cimento,* 10. *pp.* 373–382, *Dec.,* 1933.—An interferometric method of studying the arc spectra of vapours is described. Measurements have been made of the anomalous dispersion of calcium vapour in the neighbourhood of the H and K lines, *i.e.,* $1S–2P_1$ (3933·7 Å) and $1S–2P_2$ (3968·5 Å). The ratio of the intensities of the H and K lines is approximately 1 : 2. H. F. G.

1581. Optical Constants of Alkali Metals. M. I. Sergeiev and M. G. Tchernikovsky. *Phys. Zeits. d. Sowjetunion,* 5. 1. *pp.* 106–114, 1934. *In English.*—Reference is made to two papers by Kronig on the physical interpretation of the processes causing absorption and dispersion of light by metals. The authors free the theory as far as possible from arbitary assumptions and reduce the number of arbitary constants entering into it in order to make possible the quantitative interpretation of experimental curves. The theoretical results are then compared with experiment for the coefficient of reflection curves of Na and K. Very satisfactory agreement is found over a considerable portion of the long-wave region. H. L. B.

1582. Interferometer Microscope. C. Dunbar. *Journ. Sci. Instruments,* 11. *pp.* 85–89, *March,* 1934.—A mechanical stage for a microscope is described which can be moved smoothly through very small distances. Displacements of the stage are measured by means of an interferometer system, so that the magnification of the optical system can be obtained without the use of a subsidiary test object. The microscope has also been adapted to the measurement of the concentration of small particles. A second interferometer system gives the distance through which the microscope is focussed, and defines a volume in which the particles can be counted. AUTHOR.

1583. Photographic Objectives. R. Kingslake. *J.O.S.A.* 24. *pp.* 73–84, *March*, 1934.—The progressive improvement in the design and production of photographic objectives is traced from 1812 to the present day. Landscape lenses, portrait lenses, symmetrical objectives, anastigmats and telephoto lenses are discussed, the principles underlying their design analysed and their limitations described. The general principles on which the various aberrations may be corrected in a photographic objective are reviewed, including the effect of a shift in the position of the diaphragm and a discussion of the Petzval theorem. Present day tendencies and future possibilities are indicated. W. D. W.

See also Abstracts 1384, 1428, 1575, 1639, 1652, 1715, 1716.

SPECTROSCOPY.

1584. Reversal of the Red Line of Cadmium. A. Pérard. *Comptes Rendus*, 198. *pp.* 727–729, *Feb.* 19, 1934.—Spontaneous reversal of the cadmium red line has been previously noted in the Hamy lamp and also, under special circumstances, in the Michelson lamp. The effect is easily observable in the hot-kathode lamp excited by the normal current of 2 amperes, but the reversal is suppressed when the current is reduced to about 1 ampere. Using a hot-kathode lamp with a constriction at the middle of the discharge tube and a current of 1·15 amperes, the highly intense red line produced at the constriction is found to be unreversed and capable of interference over path differences up to 280 mm. Nevertheless, the opinion is expressed that the possibility of self-reversal in the red radiation of cadmium renders it unsuitable for use as the fundamental unit of length. H. B.

1585. Investigations in the Schumann Region. Part III. Spectra of Iron, Cobalt and Nickel. R. zu Dohna. *Zeits. f. Physik*, 87. 9–10. *pp.* 616–632, *Feb.* 3, 1934.—A new method for the investigation of these spectra is described. Full results are tabulated, and compared with those of other authors. [For Parts I and II see Abstracts 4542 and 4543 (1933).] W. R. A.

1586. Spectrum of Zn IV. L. and E. Bloch. *Comptes Rendus*, 198. *pp.* 645–647, *Feb.* 12, 1934.—The use of the vacuum spark of various metals brings out lines in the ultra-violet not present with the air spark and enhances the air spark lines considerably. The absence of a continuous background also brings out far more structure resolution. By the introduction of a varying self-induction in the circuit the lines of Zn IV may be picked out from Zn II and III. A table of results is given. J. E.

1587. Absorption Spectra by Excitation of Inner Electrons. Part VI. Cs Spectrum between 1020 and 600 Å under Excitation of the $(5p)^6$ Level. (Cs I^b). H. Beutler and K. Guggenheimer. *Zeits. f. Physik*, 88. 1–2. *pp.* 25–42, *Feb.* 21, 1934.—Using a He discharge tube as light source, 115 absorption lines have been observed in the spectrum of Cs vapour, of which the more intense (54) could be arranged in a term scheme. These lines correspond to the excitation of an electron in the $(5p)^6$ level in the neutral Cs atom, the valence electrons remaining unaffected. The spectrum is named the Cs I^b spectrum, and is the O_2-absorption in X-ray nomenclature. The arrangement into Rydberg series could not be carried out with certainty on account of many perturbations, the excitation of a rare gas shell being involved, when strong perturbations normally occur (cf. Xe I), while the corresponding terms are broken up further by the 6s electrons. In all 6 series $(5p)^6\ 6s \rightarrow (5p)^5\ 6s\ ms$ and 11 series $\rightarrow (5p)^5\ 6s\ md$ are found. They converge to the terms $(5p)^5\ 6s$ of $Cs^+\ P_{0,\,1,\,2}$ and $^1P_1$, of which the latter is identified by the analysis. The lines are relatively sharp. The term values of Cs I^b are well approximated by those of Ba I. [For Part V see Abstract 1164 (1934).] C. B. A.

1588. Arc Spectrum of Radium. E. Rasmussen. *Zeits. f. Physik*, 87. 9–10. *pp.* 607–614, *Feb.* 3, 1934.—The arc spectrum of radium is investigated over the range 3000-10,000 Å. The lines and terms are tabulated, and the absolute values of the latter calculated from a Bergmann series. The fundamental term is calculated to be 41,949·69 $cm.^{-1}$, equivalent to an ionisation potential of 5·176 volts. W. R. A.

1589. Arc Spectrum of Osmium. W. Albertson. *Phys. Rev.* 45. *pp.* 304–308, *March* 1, 1934.—Over 1050 osmium lines have been classified as transitions between 137 terms of Os I. J values have been assigned to all terms without the aid of Zeeman effect studies. If Hund theory is to apply to Os I then the J assignment is unique. The classification is consistent as regards absorption lines, persistent lines, intensities, and comparison with analogous spectra. Comparison with iron shows that nearly all the terms from d^6s^2 and d^7s found in Fe I have been found in Os I. The normal state of osmium is $5d^6 6s^2 (^5D_4)$. The order of $J = 2$ and $J = 3$ is inverted in the four lowest "multiplets." Electron configurations and "multiplets" overlap to such an extent that the unambiguous assignments of L and S values and electron configurations are impossible for most terms. If the term assumed to be $5d^6 6s (^6D) 7s\,^7D_4$ is correctly designated, then a simple series calculation gives 8·7 volts as an approximate value for the ionising potential of osmium. New wave-length measurements to extend the analysis are to be made using a grating having a dispersion of 0·4 Å/mm. in the second order. Evidence is presented to show that the normal electron configuration of iridium is $5d^7 6s^2$. AUTHOR.

1590. Multiplets in the Cu III Spectrum. B. V. R. Rao. *Zeits. f. Physik*, 88. 1–2. *pp.* 135–138, *Feb.* 21, 1934.—Using Bloch's values in the extreme ultra-violet and on analogy with spectra of Co I and Ni II, the energy levels $3d^8(^3F)4s\,^4F$ and ^2F, as well as $3d^8(^3F)4p\,^4F'$ and $^2F'$ have been identified for Cu III. A Moseley diagram is given from which a value 239,000 cm^{-1} is found for the $3d^8 4s\ ^4F_{9/2}$ term, corresponding to an ionisation potential of 29·5 volt. F. S.

1591. Intensity Distribution and Breadth of the Predissociation Lines of the Al-H Molecule. H. C. Burger and P. H. van Cittert. *Zeits. f. Physik*, 87. 7–8. *pp.* 545–546, *Jan.* 26, 1934.—Criticism of the work of Farkas and Levy [see Abstract 4504 (1933).] W. R. A.

1592. Fine Structure of the Balmer Lines. W. V. Houston and Y. M. Hsieh. *Phys. Rev.* 45. *pp.* 263–272, *Feb.* 15, 1934.—A new method of treating interferometer patterns of doublets has been applied to the study of the Balmer series. The method involves the measurement of the intensities of the minima between the members of the doublet and between successive orders of interference. This gives for the separations of the centres of gravity for Hβ, $\Delta\nu = 0 \cdot 3298 \pm 0 \cdot 0004$; for H$\gamma$, $\Delta\nu = 0 \cdot 3388 \pm 0 \cdot 0004$; for H$\delta$, $\Delta\nu = 0 \cdot 3451 \pm 0 \cdot 0006$; and for H$\epsilon$, $\Delta\nu = 0 \cdot 3506 \pm 0 \cdot 0006$. These values are far too small to agree with the ordinary theory of these lines and it must be concluded that the structure is not quite that expected. The discrepancy may lie in the neglect of the radiation reaction in the calculation of the energy levels. AUTHORS.

1593. Nuclear Moments of Xenon. H. Kopfermann and Eva Rindal. *Zeits. f. Physik*, 87. 7-8. *pp.* 460–469, *Jan.* 26, 1934.—The arc spectrum of Xenon, excited in a Geissler tube, is investigated for hyperfine structure in the region 8500 Å to 4500 Å. The structure of several lines is analysed and the nuclear moments of the odd Xe isotopes are determined. Xe^{129} has a nuclear moment $I = 1/2$ and from the inversion of the levels of the *s*-terms it is concluded that the nuclear magnetic moment is negative. Xe^{131} has a positive magnetic nuclear moment $I = 3/2$. The ratio of the magnetic moments $\mu 129/\mu 131 = 1 \cdot 1$. The even Xe isotopes show neither separation nor isotope displacement of any kind. J. E. K.

1594. Transition Probabilities in the Principal Series of Potassium. A. Filippov. *Phys. Zeits. d. Sowjetunion*, 5, 1. *pp.* 1–5, 1934. *In German.*—The dispersion of potassium vapour in the neighbourhood of the lines of the principal series ($4^2S_{1/2} - m^2P_{1/2, 3/2}$) has been determined with the fluorspar interferometer, and the relative values of the oscillator strengths calculated for six terms of the series. With increase of the principal quantum number the transition probabilities in the series diminish more rapidly than in the case of the corresponding sodium and lithium series. The oscillator strength for the first doublet is 46,500 times greater than that of the seventh, whilst the sum of the values for all the terms except the first is only 1 % of the value for the first term. H. F. G.

1595. Electron Terms of the Nitrogen Molecule. A. Recknagel. *Zeits. f. Physik*, 87. 5–6. *pp.* 375–398, *Jan.* 15, 1934.—The field of a single electron in the nitrogen molecule is calculated from an approximate solution of the Schrödinger equation. On the basis of the calculations of the higher terms an empirical band spectrum is formulated. F. S.

1596. Polarisation Effect of Helium D-Terms. Dipole and Quadripole Effect. E. A. Hylleraas. *Zeits. f. Physik*, 88. 1–2. *pp.* 108–113, *Feb.* 21, 1934.—In the energy terms of two-electron problems it is necessary to distinguish between three effects; the insufficient screening of the nuclear charge by the inner electrons, the exchange action between the two electrons, and the polarisation of the atomic core through the agency of the outer electron. The first two effects were worked out by the author for all term systems of helium [see Abstract 4512 (1933)]. The third effect is discussed here for the helium D-terms, in which the screening effect is small. It is shown that the quadripole moment of the atomic core exerts an appreciable influence on the Rydberg correction of the helium D-terms. H. L. B.

1597. Infra-Red Absorption Spectra of Phosphine. Lai Wing Fung and E. F. Barker. *Phys. Rev.* 45. *pp.* 238–241, *Feb.* 15, 1934.—The 10μ absorption region of PH_3 has been resolved into three bands, a pair with centres at 1121 cm^{-1} and 992 cm^{-1} in which the line intervals are approximately 11 cm^{-1}, and a single band at 990 cm^{-1} with line intervals of approximately $8 \cdot 5$ cm^{-1}. The $4 \cdot 3\mu$ band has intervals of approximately $8 \cdot 5$ cm^{-1} and its centre is at 2327 cm^{-1}. All apparently have zero branches, as do the two higher frequency bands at 3428 cm^{-1} and 4541 cm^{-1}. No absorption was observed between 16μ and 22μ. The two parallel type bands may be identified by comparison with the pure rotation spectrum observed by Randall and Wright. They are the ones at 990 cm^{-1} and 2327 cm^{-1}. The doubling observed in the corresponding bands of NH_3 does not appear here ; hence the P atom cannot pass readily through the plane determined by the three H atoms. The perpendicular type bands have intense central maxima, and do not show an intensification of every third line as in NH_3. This indicates that PH_3 behaves like a spherical top. The moment of inertia about the axis of symmetry and the interatomic distances cannot be determined precisely until information is available concerning the coupling of rotation and vibration. AUTHORS.

1598. Band Spectrum of Phosphorus Nitride. P. N. Ghosh and A. C. Datta. *Zeits. f. Physik*, 87. 7–8. *pp*. 500–504, *Jan*. 26, 1934.—A description is given of the bands in the spectrum of an uncondensed discharge which was caused to pass through a mixture of dry nitrogen and phosphorus vapour at high pressure. The bands were strongly developed. In the new series observed the bands are shaded off gradually towards the long wave side and lie in the wave-length region 2390 to 2780 Å. A list of the wave-lengths is given. J. J. S.

1599. Visible Absorption Spectrum of Iodine and the Induced Predissociation of I_2 Molecules. V. Kondratjew and L. Polak. *Phys. Zeits. d. Sowjetunion*, 4. 5–6. *pp*. 764–786, 1933. *In German*.—The absorption spectrum of iodine between 6500 and 5100 Å at various pressures and in various partial pressures of N_2, O_2, and HCl is investigated. The absorption coefficients corresponding to the absorption bands show three different maxima whose sharpness increases with the pressure. These are correlated with the predissociation of I_2 induced by collisions with other molecules. Consideration of the three most probable transitions corresponding to the three absorption maxima leads to the conclusion that they can only occur if the quantum restriction for change of the full rotation of the I_2 molecule ($\Delta J = O$) is suspended, this being effected by the collision. With increasing pressure of foreign gas, the absorption coefficients tend towards a "saturation value." The effective cross section of N_2 is deduced and is found to be 30 times larger than the gas-kinetic value. The effects for other gases, including I_2 itself, are of the same order. These results are compared with the quenching of iodine fluorescence by I_2 and N_2, and an explanation is suggested for the difference in the behaviour of I_2 and N_2 in the quenching of fluorescence and in the absorption effect. The induced predissociation is also considered in relation to other phenomena. C. B. A.

1600. Effect of Ultra-Violet Rays on Methylene Blue. C. E. Nurnberger and L. E. Arnow. *J. Phys. Chem*. 38. *pp*. 71–77, *Jan*., 1934.—The method of using the Judd Lewis sector photometer in combination with the quartz spectrograph is briefly described. The ultra-violet spectrum of methylene blue is included. Maximum absorption occurs at 292 and at 246 mμ. Exposure of methylene blue solutions to ultra-violet rays causes a decrease in the absorption bands in both visible and ultra-violet regions of the spectrum. pH has no effect on the ultra-violet spectrum of methylene blue solutions, but irradiation with ultra-violet light causes greatest change in solutions which have highest pH. The wave-lengths most active in decreasing the absorption bands of methylene blue solutions are shorter than 270 mμ. AUTHORS.

1601. Temperature Dependence of the Absorption Spectrum of Chromium Oxychloride. P. K. Peerlkamp. *Physica,* 1. *pp.* 150–154, *Jan.,* 1934. *In English.*—The effect of temperature on the absorption spectrum of chromium oxychloride has been studied. It is found that the structure in the diffuse banded portion of the spectrum between 6000 and 5300 Å, described in previous work [see Abstract 4525 (1933)] becomes much less pronounced with rising temperature, disappearing at about 220° C., while at the same time the average absorption increases noticeably there. The absorption between 5300 and 2300 Å is continuous without structure. The earlier interpretation of the spectrum is revised in view of the new data. AUTHOR.

1602. Predissociation in the Ångström-Bands of CO. D. Coster and F. Brons. *Physica,* 1. *pp.* 155–160, *Jan.,* 1934. *In English.*—Predissociation of the upper level of the Ångström bands at $v = 0$ and $J = 38$ fixes the dissociation energy of the normal CO-molecule at 9·82 volts. An electronic level diagram of CO with the dissociation states is given and the dissociation energy of most of the electronic levels could be computed. AUTHORS.

1603. Rotational Analysis of the Absorption Bands of ICl. W. E. Curtis and J. Patkowski. *Roy. Soc., Phil. Trans.* 232. *pp.* 395–430, *Jan.* 24, 1934.—Twelve bands belonging to three progressions ($v'' = 0, 1, 2$) and each consisting of P, Q and R Branches have been completely analysed. The rotation constant B has been determined to a high order of accuracy for each of the states involved with the help of a special method of eliminating errors due to blending. It is found that B′ requires a quadratic term in v' for its representation, the formula being $B'_v = 0{\cdot}083890 - 3{\cdot}828 \times 10^{-4}\,(v' + 1/2) - 3{\cdot}622 \times 10^{-5}\,(v' + 1/2)^2$. This fits seven observed values to within 0·004 %. The origins of the bands have been determined and a least squares formula calculated for the $v'' = 1$ progression as follows: $\nu = 13172{\cdot}659 + 209{\cdot}7519\,(v' + 1/2) + 1{\cdot}94741\,(v' + 1/2)^2 - 0{\cdot}033661\,(v' + 1/2)^3$. Evidence is presented which supports Darbyshire's conclusion [see Abstract 3733 (1932)] that there is a discontinuity in the law of force at about $v' = 9$ or 10. The existence of an extremely small Λ-type doubling is established and its variation with J is examined. The chief rotational and vibrational constants are evaluated. The bands are of $^3\Pi_2 \leftarrow {}^1\Sigma$ type and examination of the constants for the $^3\Pi_2$ state shows a close similarity to those of the $^3\Pi_0$ state [see Abstract 4282 (1932)]. This supports the current view that the two states are components of the same triplet level. A. H.

1604. Spectrum of MgF. F. A. Jenkins and R. Grinfeld. *Phys. Rev.* 45. *pp.* 229–233, *Feb.* 15, 1934.—Measurements of the band heads and of the partially resolved rotational structure of the MgF absorption bands are used to evaluate the following constants for the $^2\Sigma$, $^2\Sigma$ system: $\nu_{00} = 37{,}187{\cdot}4$ cm^{-1}, $B_0' = 0{\cdot}537$, $B_0'' = 0{\cdot}518 \pm 0{\cdot}010$, $r_0'' = 1{\cdot}75 \times 10^{-8}$ cm. and for the $^2\Pi$, $^2\Sigma$ system: $\nu_{00} = 27{,}846{\cdot}5$, $B_0' = 0{\cdot}529$, $B_0'' = 0{\cdot}518$, $A = -34{\cdot}3$ (or $+38{\cdot}3$). The isotope effect of Mg is observed in the + 1 sequence of $^2\Sigma$, $^2\Sigma$ bands. The BeF bands do not appear in absorption under similar conditions. AUTHORS.

1605. Spectrum of Carbon Arc in the Red Region. H. Birkenbeil. *Zeits. f. Physik,* 88. 1–2. *pp.* 1–13, *Feb.* 21, 1934.—The spectrum of the carbon arc, running under various conditions, is photographed in the region 6000 to 9000 Å, using a high-luminosity concave grating of radius 6·4 m. which gives a dispersion of 2·6 Å per mm. in the first order. The exposure times range from 1 to 7 hours. As a result of analysis of the spectra photographed under different conditions (at different air pressures and in atmospheres of nitrogen and carbon dioxide) it is concluded that what is obtained is a superposition of the red CN spectrum, the first positive group of N_2 bands, and a band spectrum due to carbon. The nitrogen bands are independently photographed and analysed. L. A. W.

1606. Vibrational Energy Level System of the Linear Molecule HCN. A. Adel and E. F. Barker. *Phys. Rev.* 45. *pp.* 277–279, *Feb.* 15, 1934.—The discovery of new rotation-vibration bands in the infra-red absorption spectrum of gaseous HCN has made possible a determination of the vibrational energy level system of the normal molecule. The agreement between theory and experiment is completely satisfactory. The fundamental frequencies of the isotopic molecule H^2CN are predicted from those found for H^1CN. AUTHORS.

1607. Continuous Spectrum of Neon. Ny-Tsi-Zé and Voo-Shueh-Ling. *Comptes Rendus*, 198. *pp.* 356–357, *Jan.* 22, 1934.—The continuous spectrum of neon at 30 mm. pressure has been compared photographically with that of hydrogen, and the variation of intensity with wave-length studied. The intensity falls slowly but regularly with decrease of wave-length from 4400 Å to 2400 Å, there being, however, a small maximum at 3400 Å. The intensities at the different wave-lengths increase in approximate proportion to the discharge current, when the latter is increased, and the continuous spectrum of neon is, therefore, not due to recombination of electrons and ionised atoms. H. F. G.

1608. Spectrum of Fluorine Oxide. A. Glissmann and H. J. Schumacher. *Zeits. f. phys. Chem.* 24. *Abt.B.* 4. *pp.* 328–334, *Feb.*, 1934.—The absorption spectrum of fluorine oxide has been photographed between 8000 and 2100 Å. Absorption begins at about 5400 Å and is continuous thereafter as the wave-length decreases. There are several maxima, notably at 4210 Å (extinction coefficient $0 \cdot 35 \times 10^{-5}$), and 3000–2800 Å ($1 \cdot 8 - 1 \cdot 9 \times 10^{-5}$). Below 2700 Å the absorption increases rapidly, the extinction coefficient at 2102 Å being 75×10^{-5}. The maxima in the longer wave-lengths corresponds with dissociation into F and O or F and FO, and that below 2100 Å probably with dissociation into 2F and O. In glass and quartz vessels light absorption results in the formation of O_2 and SiF_4. H. F. G.

1609. Zeeman Effect of Absorption Lines of Ruby. H. Lehmann. *Ann. d. Physik*, 19. 1. *pp.* 99–117, *Jan.*, 1934.—The transverse Zeeman effect of the absorption lines $R_1 = 6933 \cdot 7$ Å and $R_2 = 6919 \cdot 8$ Å, depending upon the orientation of the crystal grating to the magnetic field and plane of polarisation was investigated at − 190° C. The second order spectrum of a grating was used giving a dispersion of 4·5 Å per mm. and fields up to 27,000 gauss. The variations of the Zeeman pictures were found to follow the symmetry of the crystal grating. F. S.

1610. Paschen-Back Effect. Part I. L-S Coupling; $^3P^3D$ Multiplets of Zn and Cd. J. B. Green and D. E. Gray. *Phys. Rev.* 45. *pp.* 273–276, *Feb.* 15, 1934.—Darwin's calculations for Zeeman effect are applied to the Zn and Cd $^3P^3D$ multiplets. The frequencies and intensities thus calculated show very good agreement with the experimental values. A considerably smaller discrepancy between experiment and older quantum theory is noted for the Cd than for the Zn as should be expected because of the much larger multiplet separation in the case of the former. AUTHORS.

1611. Stark Effect of the Lyman Series. R. Frerichs. *Ann. d. Physik,* 19. 1. *pp.* 1–8, *Jan.,* 1934. *From the Reichsanstalt.*—The Stark effect of the first three lines of the Lyman series was measured using a 1 m. grating vacuum spectrograph. The number, position and polarisation of the observed components agree with theoretical expectations, but the intensities show some deviations. F. S.

1612. Intensity of Raman Spectrum of Water. A. Carrelli and F. Cennamo. *N. Cimento,* 10. *pp.* 329–332, *Aug.–Sept.–Oct.,* 1933.—The intensity of the Raman spectrum of water in the neighbourhood of the band at 3660 cm^{-1} has been determined. There appear to be three maxima, at approximately 3230, 3450, and 3560 cm^{-1} respectively. All three of the component bands partially overlap. H. F. G.

1613. Raman Effect of Nitrobenzene at Different Temperatures. H. F. Hertlein. *Zeits. f. Physik,* 87. 11–12. *pp.* 744–748, *Feb.* 19, 1934.—The Raman effect of nitrobenzene is photographed at temperatures of 3·5°, 28·2° and 52·3° C., and photometer curves of the spectra obtained are reproduced. From the identity of the effect at different temperatures it is concluded that the transition point at 9·5° C., recently found by Wolfke and Mazur by investigation of the dielectric constant and other physical properties [see Abstract 2483 (1932)], must be between two phases not differing in molecular structure. L. A. W.

1614. Raman Effect in Nitric Acid. H. Aderhold and H. E. Weiss. *Zeits. f. Physik,* 88. 1–2. *pp.* 83–91, *Feb.* 21, 1934.—The difference between the Raman spectra (4350–4910 Å) of 15 % and 90 % nitric acid is so great that it cannot be regarded as a result of ionisation changes but must be due to the existence of different types of molecules in the two solutions. For the dilute solution the spectrum is simply that of the NO_3 group, whilst at 35 % and higher concentrations typical ester lines appear. The 100 % acid is homogeneous and is of the pseudo-acid type, whilst at intermediate dilutions the true and pseudo forms coexist. H. F. G.

1615. Raman Spectrum of Sulphuric Acid. L. A. Woodward and R. G. Horner. *Roy. Soc., Proc.* 144. *pp.* 129–143, *March* 1, 1934.—Microphotometer curves of the Raman spectra of H_2SO_4 are reproduced for concentrations ranging from 100 % to 10 %. The intensity changes of certain of the lines give a clear picture of the two stages of ionisation of the acid. Thus on dilution the frequencies 910, 978, and 1121 $cm.^{-1}$ (characteristic of the H_2SO_4 molecule and present in the pure acid) rapidly vanish, while the frequency 1036 (characteristic of the HSO'_4 ion and absent in the pure acid) makes its appearance and increases in intensity. At 50 % acid another frequency 982 (characteristic of the SO''_4 ion) appears and subsequently becomes stronger. Other diffuse lines are found to change somewhat in frequency with dilution; but it is shown that their behaviour is consistent with an analysis into relatively narrow components of practically constant frequency, ascribable to the different molecular species present. On this view the characteristic frequencies come out as: H_2SO_4, 381, 555·5, 910, 978 and 1121; HSO'_4, 595, 895·5 and 1036; SO''_4, 452 and 982; while 417 and 1195 $cm.^{-1}$ are common. The inherent breadth of the lines is found to be about 25 $cm.^{-1}$. Reference is also made to the behaviour of the continuous background. Measurements on solutions of $MgSO_4$ give no evidence for a variation of the sulphate ion frequency 982 with concentration. AUTHORS.

V.
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1616. Raman Spectra of Ring Compounds. Part II. Poly-Substituted Benzene Compounds. J. W. Murray and D. H. Andrews. *J. Chem. Phys.* 2. *pp.* 119–124, *March*, 1934.—The Raman spectra of fluorobenzene, 1,2,4-trichlorobenzene, 1,2,4,5-tetrachlorobenzene, pentachlorobenzene, hexachlorobenzene, and hexamethylbenzene have been studied. Their relation to the vibrations of the benzene ring is discussed. [For Part I see Abstract 3605 (1933).] AUTHORS.

1617. Raman Effect of Arsenic Trifluoride and the Molecular Constants of AsF_3, $AsCl_3$ and PCl_3. D. M. Yost and J. E. Sherborne. *J. Chem. Phys.* 2. *pp.* 125–127, *March*, 1934.—The Raman spectrum of AsF_3 was found to consist of four lines with the frequencies $\omega_1(1)$, 707; $\omega_2(1)$, 341; $\omega_3(2)$, 644; and $\omega_4(2)$, 274 $cm.^{-1}$. The selection rules require a pyramidal molecule. Electron diffraction data for AsF_3, $AsCl_3$ and PCl_3 are used to establish the bond angles. The entropies of the three trihalides were calculated, and the standard free energies of formation of $AsCl_3(l)$ and $AsCl_3(g)$ were determined to be −65,190 cal. and −62,718 cal., respectively, at 25°. AUTHORS.

1618. Raman Effect of Arsenic Trichloride in Solution. A. E. Brodsky, A. M. Sack and S. F. Besugli. *Phys. Zeits. d. Sowjetunion*, 5. 1. *pp.* 146–152, 1934. *In German.*—Raman spectra are observed for $AsCl_3$, CCl_4 and benzene, and for solutions of $AsCl_3$ in the other two liquids. It is found that the Raman frequencies of the non-polar solvents remain unchanged in the solutions, but that the frequencies of the $AsCl_3$ show small displacements. L. A. W.

1619. Spectrographic Determination of Impurities in Copper. R. Breckpot. *Ann. Soc. Sci. de Bruxelles*, 53. *pp.* 219–247, *Dec.* 30, 1933. —A description of an arc spectrum method for the quantitative investigation of impurities present to the extent of 0·001 to 1 %. The technique for the intensity measurements is described. In order to minimise the effect of fractional distillation in the arc the substance under investigation should be placed on the kathode of a pure graphite arc, and the current kept low. Tables are given describing results for traces of Pb, Bi, Ag, Sb and As. W. R. A.

1620. Optics and Electronics of Solids and Liquids. R. Tomaschek. *Die Physik*, 2. 1. *pp.* 33–46, 1934.—A review and bibliography of the literature prior to July, 1933, in the following subjects:—(1) Absorption and emission spectra: line absorption and emission, diffuse band spectra of crystals, selective absorption of metals, spectra associated with electronic transitions, absorption in liquid solutions and residual rays. (2) New phosphorescent and fluorescent materials and their preparation: emission of light by pure substances (metals under electron bombardment, solidified gases, fluorescence of inorganic and organic compounds), phosphors, fluorescent and phosphorescent solutions. (3) Theories of the structure of phosphorescent centres. (4) Chemi-luminescence. (5) Decay of fluorescence. C. B. A.

1621. Spectroscopy and Valency. Part II. Periodic Groups of Non-Hydride Diatomic Molecules. C. H. D. Clark. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 502–512, *Jan.*, 1934.—The classification of diatomic molecules (excluding hydrides) here proposed is based upon the following three quantities for a diatomic molecule XY: (*i*) the number of non-bonding electrons associated with X (non-bonding electrons being those more or less closely associated with the atomic nuclei and preserving approximately the configuration present in the constituent atoms prior to combination) ; (*ii*) the number of non-bonding electrons associated with Y ; and (*iii*) the number of bonding or shared electrons. The classification paves the way for a systematic discussion of the properties of diatomic molecules, a task to be attempted in a subsequent paper. [For Part I see Abstract 3747 (1932).] L. A. W.

1622. Spectrophotography of " Flash " Sources or Sources of Low Intensity. W. Kraemer. *Zeits. f. Instrumentenk.* **54.** *pp.* **45–48,** *Feb.*, **1934.**—Further tests have been made with the apparatus described previously [see Abstract 260 (1933)] and values are tabulated for the wave lengths found for Fe, Ta, Nb, Eu, Th, Hf, Ti, Al, Zr and Mb. These values are compared with the international values in some cases and with those found by Twyman, Kayser, Löwe, Smith and Gramont in other cases. In all cases very good agreement results. R. S. R.

See also Abstracts 1382, 1451, 1554, 1557, 1563, 1567, 1568, 1569, 1577, 1580, 1707.

VISION.

1623. Apparatus for Reading with Closed Eyes. A. H. Pirie. *Brit. J. of Radiology,* **7.** *pp.* **111–116,** *Feb.*, **1934.**—The principle used in the apparatus is that X-rays stimulate the retina. If letters in lead are passed in front of the closed eye on which X-rays are falling, upright shadows are cast on the retina and can be recognised. The chief use of the apparatus is to localise foreign bodies in or near the eye, to trace damage to the retina and to investigate the eye in cases of complete cataract. It is possible for a second person to see a splinter of glass by fluorescence in an eye if very powerful beams of X-rays are used. H. M. B.

See also Abstract 1528.

X-RAYS.

1624. Modern X-Ray Developments. A. Bouwers. *Brit. J. of Radiology,* **7.** *pp.* **21–32,** *Jan.*, **1934.** *Silvanus Thompson Memorial Lecture.*—Summarises modern developments and tendencies in the design of X-ray tubes and h.t. generators. Among tube improvements is a method of improving the cooling of those with rotating anodes in which a number of cylindrical extensions on the anode overlap an equal number of cylinders connected to a massive cooling body. The surfaces of the cylinders are blackened to assist in the interchange of heat between the rotating and stationary cylinders. For diagnostic radiology a very compact outfit embodying a h.t. transformer of the shell-type with a small X-ray tube contained in a pole in the middle has been made. This apparatus only weighs 10 lb., but is capable of making a radiograph of a skull in 3 sec. A new type of dull emitter rectifying valve of the mercury vapour type is mentioned, and a compact 400 kV incorporating valves of this type is described. This generator, which involves a voltage-multiplying arrangement of valves and condensers is only 8 ft. high. Some of the difficulties encountered in making h.t. X-ray tubes are noted, and it is shewn that the effect of secondary electrons can be minimised by the correct proportioning of the electrodes. G. E. B.

1625. Efficiency of X-Ray Production. O. Gaertner. *Zeits. f. techn. Physik,* **15. 2.** *pp.* **59–62, 1934.**—The energy of the radiation emitted by a Philips Metallix tube at constant voltage is measured by a thermopile. Between 61 and 100 kV the efficiency, allowing for absorption in the window, is 0·37 %. Radiation of wave-length greater than 1·0 Å is not measured. A Müller Metro tube at 90 kV gives the same energy as the Metallix tube. The weakening of unfiltered radiation due to passage through 1 mm. of aluminium is measured thermally and ionometrically and the results are compared. J. T.

1626. Multiple X-Ray Scattering. H. Hulubei. *Ann. de Physique,* 1. *pp.* 5–71, *Jan.,* 1934.—Monochromatic X-rays, scattered by substances of low atomic weight, are examined, with a Cauchois spectrograph for the presence of a band of frequencies produced by multiple Compton scattering. Lithium and paraffin were used as the radiators and the angles of scattering varied between 0° and 130°. Evidence was obtained of the presence of a band of frequencies in the scattered radiation having a width corresponding to that which would be expected if individual quanta underwent two successive inelastic impacts. In some cases indications of triple scattering were obtained. Notes are added to the paper (*a*) on the negative result obtained in an investigation of an electronic Raman effect (or " partial absorption ") in the X-ray region and (*b*) on measurements made of the wave-length of certain non-diagram lines in the K-emission spectra of Mo and Rh. J. E. R. C.

1627. Law of Photographic Darkening for Very Soft X-Rays. H. Brolli and H. Kiessig. *Zeits. f. Physik,* 87. 7–8. *pp.* 425–431, *Jan.* 26, 1934.—Density curves are obtained for the C wave-length 45 Å and are compared with those for the wave-length 1·45 Å of the Kα-radiation of Cu for various emulsions. The relative sensitivities are obtained for these two wave-lengths. The density-time curves for the C radiation are found to be strongly curved, whereas those for the Cu radiation exhibit an almost linear relationship. The curve for the C radiation shows a small but definitely measurable threshold value for Agfa contrast plates. H. L. B.

1628. K-Series of Aluminium and Magnesium. H. Karlsson and M. Siegbahn. *Zeits. f. Physik,* 88. 1–2. *pp.* 76–82, *Feb.* 21, 1934. —The K-spectra of Al and Mg are registered with the help of a high-vacuum spectrometer, having a curved crystal and giving great intensity. An investigation is made of the difference in the spectra of the elements in the metallic state and as non-conducting oxides. This leads to an interpretation of the β^{III} and β^{IV} lines. New satellites are found in the Kα-group. H. L. B.

1629. Fine Structure of X-Ray Absorption Edges and the Influence of the Polar Character of the Compound. D. Coster and G. H. Klamer. *Physica,* 1. *pp.* 145–149, *Jan.,* 1934. *In English.*—Whereas in the case of metal alloys, as previously shown [see Abstract 2460 (1932)] the type of fine structure of X-ray absorption edges mainly depends on the crystal lattice, the fine structures of the potassium and chlorine K-edge in an ionic crystal as KCl are totally different. In the case of $KClO_3$ the fine structures of potassium and chlorine differ from one another as well as from those of the corresponding elements in KCl. AUTHORS.

1630. K-Absorption Edges of C, N and O. Structure of Carbon Kα Line. F. C. and L. P. Chalklin. *Phil. Mag.* 17. *pp.* 544–553, *March,* 1934.—A grating spectrograph with Mo antikathode is used. The carbon, nitrogen and oxygen whose K-absorption edges are measured occur in the spectrograph as traces of residual gas. Since the X-ray tube is connected to the spectrograph, these gases also produce emission spectra which tend to obscure the K-edges. These emission spectra appear to originate from gas layers on the antikathode surface so that they can be avoided by allowing the antikathode to run hot. Measurements of the K-edges are recorded and compared with those of other authors. The carbon Kα emission line is also studied. It appeared to have a structure consisting of a strong component at 44·74 Å and a weak component at 43·88 Å. J. E. R. C.

1631. Influence of Divergence of Primary X-Ray Beam on Diffraction Photographs. F. Lihl. *Ann. d. Physik,* 19. 3. *pp.* 305–334, *Feb.,* 1934.—Exact formulæ which take into account the divergence of the primary X-ray beam, are given for calculating the angle of reflection from the positions of the outer and inner edges of the interference lines obtained by three methods in which "back reflections" are utilised. A method is given by which the angle of reflection may be accurately determined even when the distance from specimen to film is not accurately known. Curves are given connecting the shift of the interference lines and their breadth with the divergence of the primary beam. The three methods in question: namely methods using a conical film, a plane film and a cylindrical film, are discussed, and it is decided that the conical film method is the most useful. J. T.

1632. X-Ray Ionoquantimeter. E. Hasché. *Zeits. f. techn. Physik,* 15. 2. *pp.* 68–72, 1934.—Describes in detail a thermionic valve ionoquantimeter, which is developed from the Siemens dosimeter, as designed by G. Bucky, with addition of the bridge connection of Wynn-Williams and Brentano, and is operated directly from the mains, instead of by accumulators or dry batteries. The scheme of connections is described and illustrated and the general characteristics of the connections, in respect to adjustment, sensitivity, construction and calibration and the reliability and steadiness of the readings discussed. B. J. L.

1633. Use of X-Rays in Measurement of Strain. R. Berthold. *Zeits. f. techn. Physik,* 15. 1. *pp.* 42–48, 1934.—The change in position of the X-ray interference-lines obtained by back-reflection is used as a measure of the strain in steel used in construction work. The accuracy of the results is in the region of ± 1 to ± 5 kg./mm.^{2} Heat-treatment processes are controlled by observation of changes in line-breadth of the interference-lines. J. T.

1634. X-Ray Spectroscopy. (Miss) Y. Cauchois. *Ann. de Physique,* 1. *pp.* 215–266, *Feb.,* 1934.—In the first part of the paper a focussing method is described, which is based on reflection by a curved crystal. A divergent X-ray beam is employed and it is shown mathematically that with a suitable arrangement the reflected beams from various portions of the crystal are brought to a focus. In the second part of the paper the measurement of the K-series of Kr is described. The K-radiation of Kr is excited by a beam of electrons from a Lenard-Coolidge tube and is analysed by means of the curved crystal method described in the first part. J. T.

1635. X-Ray Spectroscopy with Curved Crystalline Reflectors. Part II. L. v. Hámos. *Ann. d. Physik,* 19. 3. *pp.* 252–260, *Feb.,* 1934. —A new focussing X-ray spectrometer is described in which a cylindrically curved rock-salt crystal reflector is used. The constructional details and methods of adjustment are explained and some spectra are reproduced to demonstrate the performance of the instrument. [See Abstract 4566 (1933).] J. E. R. C.

See also Abstracts 1473, 1560, 1623, 1752.

HEAT.

CALORIMETRY.

1636. Specific Heat of Aqueous Solutions of Strong Electrolytes. A. G. Samoylovich. *Phys. Zeits. d. Sowjetunion*, 4. 5–6. *pp.* 843–853, 1933. *In German.*—An attempt is made to explain the dependence of the specific heat of electrolytic solutions on concentration by considering the effect of ionic hydration and the influence of the ions on the state of polarisation and polymerisation of the solvent. Author.

1637. Specific Heat of Thallium at Liquid Helium Temperatures. W. H. Keesom and J. A. Kok. *K. Onnes Lab. Leiden, Comm. No.* 230c, 1933. *Physica*, 1. *pp.* 175–181, *Jan.*, 1934. *In English.*—Specific heats of thallium were measured from 1·3 to 4·2° K. The atomic heat of thallium shows a change of 0·00148 cal./°K. mol. at the transition point. This agrees with Rutgers' equation. No latent heat was observed at the transition point. Authors.

See also Abstract 1641.

CONDUCTION.

1638. Thermal Conductivity of Chemically Related Substances in the Fluid State. A. Kardos. *Zeits. f. techn. Physik*, 15. 2. *pp.* 79–80, 1934.—The thermal conductivity has been plotted against molecular weight for nine series of similarly constituted organic liquids. With three exceptions all lie on descending curves convex to the molecular weight axis. The normal alkyl chlorides show a linear relation ; the C_nH_{2n+2} series shows the usual zigzag according as *n* is odd or even ; for the benzene series the curve is concave to the molecular weight axis, with a maximum for toluene. C. A. S.

See also Abstract 1520.

DILATATION.

1639. Thermal Expansion of Boron-Trioxide Glass. M. E. Spaght and G. S. Parks. *J. Phys. Chem.* 38. *pp.* 103–110, *Jan.*, 1934.—By use of a small dilatometer with mercury as the dilatometric fluid the coefficients of thermal expansion of two samples of boron trioxide have been measured between 100° and 325° C. with a probable experimental error of less than 5 %. The coefficient for the viscous liquid was found to be more than ten times that for the glassy state. The character of the expansion coefficient-temperature curves below 260° C. depended greatly upon the extent of the annealing during the initial formation of the glass. Authors.

See also Abstract 1641.

MELTING AND BOILING POINTS.

1640. Evaporation Technique for Highly Refractory Substances. H. M. O'Bryan. *Rev. Sci. Instruments*, 5. *pp.* 125–126, *March*, 1934.—Platinum, boron, molybdenum, quartz and other substances have been evaporated in a vacuum from a crucible heated by bombardment with electrons at 4000 volts from a tungsten filament. A small pure graphite crucible was heated to its melting point about

3500° C. by 100 mA of electron current. Most elements will alloy with a tantalum or molybdenum crucible so a graphite cup is usually preferable. Low melting point substances which would easily alloy with a tungsten filament can be readily handled by this method, which has been used in the preparation of X-ray target surfaces, small mirrors and absorbing films. AUTHOR.

See also Abstracts 1404, 1428, 1467, 1468, 1649, 1653.

TEMPERATURE, MEASUREMENT OF.

1641. Thermal Apparatus and Measurements. F. Henning. *Die Physik*, 2. 1. *pp*. 1–10, 1934.—A review is given of recent developments in the measurement of thermal expansion, standard and very high and very low temperatures, small vapour pressures and the temperatures of hot gases and flames. Calorimetry, thermoelectric and resistance thermometry, radiation pyrometry and heat radiation measurements are also briefly discussed. H. J. H. S.

1642. Mercury-in-Glass Thermoregulator. C. C. Coffin. *Nova Scotian Inst. Sci., Proc.* 18. 3. *pp*. 213–214, 1932–1933.—A mercury-in-glass thermoregulator capable of controlling bath temperatures to within 0·001° C. is described. AUTHOR.

1643. Thorium Oxide, a High-Temperature Refractory. O. O. Fritsche, H. B. Wahlin and J. F. Oesterle. *Am. Electrochem. Soc., Trans.* 64. *pp*. 329–339, 1933.—Thorium oxide may be fused easily in a smothered carbon arc furnace without the formation of carbide. Using moulds of electrode graphite, shapes may be burned in a h.f. induction furnace at 1600° C. After removal from the mould the shapes are finished by heating at 1000° C., reburned at 1600° C. and then reheated at 1000° C. to remove any carbide. The finished product is not glazed but is fairly strong. F. J. W.

1644. Production of Low Temperatures. F. Simon. *Zeits. f. Physik*, 87. 11–12. *pp*. 815–818, *Feb*. 19, 1934.—The paper, which deals with the " desorption " method of producing low temperatures, is primarily a reply to a recent contribution on this subject by Justi [see Abstract 1222 (1934)]. The present author has successfully liquefied hydrogen by this method, and considers the cooling produced by the " desorption " to be considerably in excess of that produced by the expansion of the gas. R. W. P.

See also Abstracts 1443, 1672.

THERMOCHEMISTRY.

1645. Valence. Theoretical Calculation of Energy of Aromatic Compounds. H. Tamaki. *Phys. Math. Soc., Japan, Proc.* 16. *pp*. 52–66, *Feb*., 1934. *In English*.—The author has calculated the combining energy of some aromatic compounds by means of Heitler-Weyl's theory of chemical valency, and has examined their stabilities by an extension of Rumer's method. The energy level of an hexagonal ring of trivalent radicals was found to be nearly equal to that of three pairs of them. In the case of the benzene ring, if each CH-radical may be considered as a trivalent atom, its large combining energy cannot be explained by the Heitler-Weyl theory which gives the energy level as nearly equal to that of a diatomic molecule. If, however, the idea of directional valency be taken into consideration, an explanation is afforded for the greater stability of the benzene ring as compared with acetylene. H. H. Ho.

1646. Upper Pressure-Limit of Ignition. N. Semenoff. *Phys. Zeits. d. Sowjetunion,* 4. 5–6. *pp.* 709–722, 1933. *In English.*—The existence of an upper pressure-limit of ignition appears to be characteristic of any oxidation process in the gas phase, and is associated with the rupture of the reaction chain due to the disappearance of the oxygen atom during a triple encounter of the latter with two other molecules. The upper limit of partial pressure $(O_2)_2$ must be distinguished from that of total pressure p_2. Experimental data indicate that, for large concentrations of oxygen, $(O_2)_2$ is proportional to $\sqrt{(B)}$, where (B) is the pressure of the second reactant. The same law, deduced theoretically, is based on the hypothesis of three body collisions. A definite relationship between the value of the upper limit and the amount of inert or active gases added to the oxygen is established. Some constants characterising chain-reactions are computed. The relationship between p_1 and p_2 (the lower and upper pressure limit) is established for mixtures of $H_2 + O_2$ and $CO + O_2$, and a theory of the upper pressure limit of ignition of these mixtures is proposed. N. M. B.

1647. Detonation in Gaseous Mixtures. Part I. Detonation Characteristics. A. Sokolik and K. Shtsholkin. *Phys. Zeits. d. Sowjetunion,* 4. 5–6. *pp.* 795–817, 1933. *In English.*—An investigation of flame propagation in CH_4-O_2 mixtures at different initial pressures below atmospheric, by means of a photographic method shows that detonation takes place below 100 mm. pressure, and a close connection between the pre-detonating length and the initial pressure and tube length is found. The transition from detonating to non-detonating combustion with reduction of tube-length and the appearance of return waves is treated experimentally and theoretically. The significance of the volume of the gas mixture in front of the flame boundary as a condition for the development of detonation is shown, and the velocity of the detonating wave has been measured and found to be practically independent of the initial pressure. The origin of this wave is discussed thermodynamically and by chemical kinetics. The theory suggested to account for the wave can be applied to the phenomena of knocking in internal combustion engines, thus confirming the common origin of these phenomena. N. M. B.

THERMODYNAMICS.

1648. Nernst's Free Energy Equation. H. Schmolke. *Zeits. f. Physik,* 88. 1–2. *pp.* 139–142, *Feb.* 21, 1934.—It is shown that the equation for free energy, in the form given by Nernst, is mathematically sound although in unusual notation. T. L. M.

1649. Series of Coefficients Common to Thermal Agitation Phenomena. P. Weiss. *Comptes Rendus,* 198. *pp.* 302–304, *Jan.* 22, 1934.—The author finds that for high densities the coefficient of perfect gases, R, is replaced by a higher coefficient which for different cases is always a member of an arithmetic progression $R(1 + 0{\cdot}0475n)$. He now shows that the values of the factor F, entering into the theory of Forrer's law (Curie points), follow the same progression very closely. Féry has found abrupt changes in the electrical resistance of platinum for certain temperatures; these temperatures are shown to fall into the same progression, the initial term being the Forrer factor for iron. No explanation is offered. T. L. M.

1650. Refraction of Adiabatics. E. Jouguet. *Comptes Rendus,* 198. *pp.* 409–413. *Jan.* 29, 1934.—A theory, which is a generalisation of previous work, is developed and applied to special cases, *e.g.*, the refraction of adiabatics in the P–V diagram in the case of the vaporisation of a pure fluid; the refraction of isobars in the entropy diagram for a pure liquid; the refraction of isotherms in the P–V diagram for a mixture of two fluids. J. P. A.

1651. Specific Heats of Real Gases. E. J. M. Honigmann. *Zeits. f. Physik,* 87. 9–10. *pp.* 659–668, *Feb.* 3, 1934.—A real gas is defined as one for which $d(PV) = \{(n-1)/n\}dJ$, or $d(PV) = (n-1)dU$, where J is the total heat, U the internal energy, and n a constant characterising the gas. For an ideal gas $n = C_p/C_v$. In a full thermodynamic investigation, formulæ for the various specific heats of a real gas are worked out and discussed. J. P. A.

1652. Variations of the Thermal Behaviour of Methane at 20·4° Abs. as a Phase Transition of the Second Order. K. Clusius and A. Perlick. *Zeits. f. phys. Chem.* 24. *Abt.B.* 4. *pp.* 313–327, *Feb.,* 1934.—Thin layers (0·1 mm.) of solid methane are isotropic at temperatures below 20·4° Abs.; transparent crystals 3 mm. thick, however, exhibit double refraction when cooled in liquid H_2, and on further reduction of temperature, to 15° Abs., the double refractivity increases, although there is no evidence of recrystallisation. The molecular specific heat of solid methane is 3·3 cal. at 16·5° Abs., 10 cal. at 19·8° Abs., 71·6 cal. at 20·35° Abs. and 12·0 cal. at 20·5° Abs.; at 21·2° a normal value, which increases in the usual way with rise of temperature, is reattained. The specific heat—temperature curve is reproducible provided the specimen is first cooled to below 16° Abs.; if this is not done, the maximum value varies, although it always occurs at the same temperature. With rise of pressure this temperature increases (to 21·37° Abs. at 200 kg. per cm.^{2}). The value of $\Delta(\delta v/\delta\tau)$ is 0·762 c.c. per degree. The discontinuity of behaviour is ascribed to a transition of the second order, as described by Ehrenfest [see Abstract 5378 (1933)]. H. F. G.

1653. Phase Diagram of Mg-Sb System. G. Grube and R. Bornhak. *Zeits. f. Elektrochem.* 40. *pp.* 140–142, *March,* 1934.—26 Mg-Sb alloys, ranging from pure Mg to pure Sb, are investigated by the method of thermal analysis, and the results are embodied in a complete phase diagram for the system. The diagram closely resembles that for the system Mg-Bi. Two eutectic points are found at 10 and 86 atomic % Sb. The only compound formed is Mg_3Sb_2, which has the very high melting point of 1228° C. (m.pt. of Mg, 650° C.; of Sb, 630° C.). Like Mg_3Bi_2, this compound forms mixed crystals to a small extent with excess Mg and exists in two polymorphic forms. The phase diagram is partially confirmed by microscopic examination of specimens. L. A. W.

1654. Electrical Conductivity and Phase Diagram of Mg-Bi System. G. Grube, L. Mohr and R. Bornhak. *Zeits. f. Elektrochem.* 40. *pp.* 143–150, *March,* 1934.—Earlier investigation of the system Mg-Bi by thermal analysis [see Abstract 976 (1906)] had indicated the existence of only one compound Mg_3Bi_2. In the present work this result is confirmed, a range of alloys being investigated by measurement of electrical conductivity, by thermal analysis and by microscopic examination. The melting point of the compound is shown, however, to be 823° C.—more than 100° C. higher than previously supposed. At about the temperature formerly regarded as the melting point of the compound is found a transition between two different forms: for the pure compound, at 700° C.; and for the mixed crystals with Mg, at 686° C. The region of homogeneity of these mixed crystals, and the solubility of Bi in solid Mg, are determined by conductivity measurements. In the concentration range 30 to 35 atomic % of Bi the conductivity measurements give non-reproducible results; but no explanation of this can be found. L. A. W.

1655. Electrical Conductivity and Phase Diagram of Li-Mg System. H. Grube, H. v. Zeppelin and H. Bumm. *Zeits. f. Elektrochem.* 40. *pp.* 160–164, *March,* 1934.—A number of Li-Mg alloys, ranging from pure Li to pure Mg, are investigated by thermal analysis, and the results are confirmed by electrical conductivity measurements on the solids and by X-ray powder photographs. The results are embodied in a phase diagram for the system. On cooling, the melt is found to give homogeneous mixed crystals in the concentration ranges 0 to 16·3 and 28·6 to 100 atomic % of Li. At 21·8 % Li and 587·5° C. is a eutectic point, at which crystallises a heterogeneous mixture of mixed crystals (rich in Mg) and a phase richer in Li. As to the nature of this phase, a flat maximum in the liquidus at about 28·6 % Li indicates the probable existence of an intermetallic compound with the formula Li_2Mg_5. This forms a continuous range of mixed crystals with Li and has the same lattice structure as Li. L. A. W.

1656. Entropy Diagram of Liquid Helium. W. H. Keesom and (Miss) A. P. Keesom. *K. Onnes Lab., Leiden, Suppt. No.* 76*c*, 1933. *Physica,* 1. *pp.* 161–166, *Jan.,* 1934. *In English.*—An entropy diagram is derived for liquid helium and some observations are given in connection with it. [See Abstract 731 (1934).] AUTHORS.

1657. Thermodynamic Properties of Helium Gas. J. R. Roebuck and H. Osterberg. *Phys. Rev.* 45. *pp.* 332–340, *March* 1, 1934.—The Joule-Thomson coefficients of the preceding article [see Abstract 1561 (1933)] and the *pv* data of Holborn and Otto are here used to calculate the most important thermodynamic properties of helium. The variation of the specific heat with pressure is small. The computed values of the specific volumes compare excellently with those from the data of Holborn and Otto. Simple relationships are shown to exist between the coefficient of free expansion η and the intrinsic energy variation λ. Convenient equations are derived for computing these coefficients; η is independent of the pressure and λ is proportional to the square of the pressure except at the lowest temperatures. Both η and λ are zero at about − 70° C., are positive below this temperature and are negative above. Their numerical value above − 70° C. is everywhere small. The pressure and temperature behaviour of η and λ is explained by a kinetic theory taking into account the change in the total potential energy stored by collision between the helium atoms when the pressure is altered. The law of force between two helium atoms, consistent with this theory, is of the type giving rise to the same mutual potential energy of two helium atoms as deduced from considerations of the quantum theory. It is extremely doubtful that the trend of η at high temperature leads ultimately to the perfect gas state. AUTHORS.

See also Abstract 1474.

VAPOUR PRESSURE.

See Abstracts 1466, 1641.

ACOUSTICS.

1658. Magnetic Analogues of Forces Due to Vibration. L. Marty. *Rev. d'Acoustique,* 2. *pp.* 413–440, *Nov.,* 1933.—The paper, which describes both original matter and work already reported in Bouasse's *Tourbillons,* is concerned with "acoustical forces" or forces called into play when an obstacle is placed, for example, in a stationary wave system. These forces are to be ascribed to unsymmetrical pressures occasioned by the unsymmetrical distribution of fluid velocity around the body. Experimental methods and the technique for the study of the forces are described in detail and drawings of lines of vibration, or envelopes of vector velocities, which characterise the fluid fields, are given for a number of systems. In the second part of the paper the author, building on the work of Bjerknes, shows that the existence, direction and sense of these forces are those which may be foretold from magnetic analogues in which the lines of vibration are replaced by magnetic lines of force. Unfortunately, the forces are usually masked by circulations of which the theory takes no account. E. J. I.

1659. Acoustic Spectrum of Elastic Body Submitted to Shock. M. Biot. *Acoustical Soc. of America, J.* 5. *pp.* 206–207, *Jan.,* 1934.—The general theorem proved in a previous paper [see Abstract 1818 (1933)] is applied to two special cases, *viz*: (1) A constant force acting during a finite time T upon an elastic system, (2) a load suddenly applied to the centre of a stretched string. In the first case the calculated intensities of the normal modes of vibration which result show a group distribution in accordance with experiment. J. P. A.

1660. Angular Distribution of Sound Produced by a Large Diaphragm. R. Ruedy. *Canad. J. of Research,* 10. *pp.* 134–144, *Jan.,* 1934.—The amplitudes of the sound waves set up by a thin circular plate clamped at the edge and vibrating with circular and radial nodes, have been calculated for distances which are large with respect to the radius of the disc (loudspeaker). The results are compared with those obtained at various frequencies when a rigid oscillating piston set into an infinite wall is used as a source or reproducer of sound. The two main differences between the vibrating plate and piston are (1) much greater amplitudes obtained in certain directions when the diaphragm is used, even though the displacement at the centre of the disc may be the same in both cases, and (2) the strong tendency to send the sound sideways instead of directly forward. While the diaphragm shares these properties to a certain extent with the stretched membrane, it displays them in a more practical range. The theoretical frequencies at which these features are found to be most pronounced are in agreement with the values found by experiment. AUTHOR.

1661. Damping of Vibrations in Mica. E. Orowan. *Zeits. f. Physik,* 87. 11–12. *pp.* 749–752, *Feb.* 19, 1934.—In a piece of mica as ordinarily cut, vibrations appear strongly damped, and the note emitted resembles that from a piece of paper. If, however, the specimen is cut with a diamond saw, so as to leave no frayed edges, the note is metallic and undamped. The damping has therefore no connection with the internal structure of the mica. J. P. A.

1662. Resonance in Soft-Walled Cylinders. J. C. Cotton. *Acoustical Soc. of America, J.* 5. *pp.* 208–212, *Jan.*, 1934.—Cylindrical resonators, 14 cm. long and 1·9 cm. dia., were made from (*a*) packed ground beef steak, (*b*) wet packed cotton waste, and (*c*) plasticine, and were tested for resonant intensity over the frequency range 200 to 1800. From the graphs obtained it is found that the fundamental resonant frequency of a soft-walled cavity is higher than for a similar rigid-walled cavity, and harmonics of this fundamental do not follow in their normal odd harmonic order. Further, soft walls limit the ability of the resonator to radiate energy. Plasticine is too rigid to represent a vocal resonator. G. E. A.

1663. Struck String. M. Ghosh. *Phil. Mag.* 17. *pp.* 521–544, *March*, 1934.—Deals with a theory of the impact of a yielding hammer with a damped stretched string. At the beginning and end of the impact Hertz's law of compression holds and, in between, Hooke's law. Algebraic difficulties prevent the extension of the general expressions for the displacement of any point of the string during contact, and for the pressure beyond the third epoch. As the string is assumed semi-infinite, the results can be applied only to examples where the impact is over before the first wave reflected from one of the bridges reaches the point of impact. Some special cases of the finite string are discussed together with comparisons with other theories. It is deduced that for a felt-covered hammer the duration of the impact depends upon the initial velocity of the hammer. W. H. Ge.

1664. Optical Experiments on the Reflection of Ultrasonic Waves. E. Hiedemann and H. R. Asbach. *Zeits. f. Physik*, 87. 7–8. *pp.* 442–446, *Jan.* 26, 1934.—The diffraction of light in liquid media traversed by ultrasonic waves is used to investigate the ultrasonic field. The reflection of ultrasonic waves at concave and convex cylindrical mirrors is recorded photographically. More complicated diffraction phenomena present themselves when the liquids are traversed by ultrasonic waves in different directions: in some cases the effect is that of a plane lattice, in others that of space lattices. H. L. B.

1665. Ultrasonic Waves in Liquids. C. Bachem, E. Hiedemann and H. R. Asbach. *Zeits. f. Physik*, 87. 11–12. *pp.* 734–737, *Feb.* 19, 1934.—A method of observing ultrasonic stationary waves in liquids is described. At the pressure nodes, where the density is constant, the optical transparency of the liquid is greater than that at the antinodes. This is rendered visible by an adaptation of the Schlieren method and a ready means is thus afforded for the measurement of the velocity of ultrasonic waves in liquids. [See following Abstract.] J. E. R. C.

1666. Observation of Progressive Ultrasonic Waves in Liquids. C. Bachem, *Zeits. f. Physik*, 87. 11–12. *pp.* 738–740, *Feb.* 19, 1934.—A liquid traversed by ultrasonic waves is observed by a Schlieren apparatis [see preceding Abstract]. Intermittent illumination is provided by means of a pair of nicol prisms and a Kerr cell in the path of a beam of light, the Kerr cell being connected to the circuit which generates the waves. It is thus possible to measure the velocity of the waves. J. E. R. C.

1667. Acoustical Treatment of a Theatre. W. Crone, H. Seiberth and J. Zenneck. *Ann. d. Physik*, 19. 3. *pp.* 299–304, *Feb.*, 1934.—The Prinzregententheater at München suffered from some peculiar echoes. The method used to determine the origin of these echoes is described. J. E. R. C.

1668. Sound Insulation Due to Walls. A. Gemant. *Zeits. f. Physik*, 87. 11–12. *pp*. 700–705, *Feb*. 19, 1934.—It is pointed out that there are two processes by which the transmission of sound through a wall may be visualised to occur. These are (1) the incident sound causes diaphragm vibrations of the wall, and (2) some of the incident sound is transmitted *through* the material of the wall. It is shown that these will only lead to the same result provided that plane waves incident normally upon thin walls which are infinite in extent are considered. The factors which cause deviations between the theoretical and experimental sound reduction factors are discussed and it is concluded that resonances and the fact that only part of the wall moves (due to its being fixed at the edges) are the chief causes of the discrepancies. J. E. R. C.

1669. Sound Measurement versus Aural Judgment of Loudness. P. H. Geiger and E. J. Abbott. *Elect. Engineering*, 52. *pp*. 809–813, *Dec*., 1933.—The paper describes tests which were carried out under essentially practical conditions to determine the relation between the judgment of a group of observers and the readings given by a total noise meter. The instrument used consisted of a Western Electric condenser microphone, first stage amplifier, volume control amplifier, weighting network, rectifier and indicating meter. The weighting network was adjusted so that the overall response frequency corresponded to Kingsbury's 60 db loudness contour. The results obtained show close agreement between the meter readings and the average judgments of a group of observers. The noise meter readings are markedly superior to the judgment of any single observer. It is to be noted that in this paper the term loudness is defined as " the magnitude of the sensation produced for the average normal ear." It is not, therefore, a meter measurement but the average judgment of a group of observers. F. S. B.

1670. Defects of Hearing. H. Sell. *Zeits. f. techn. Physik*, 15. 1. *pp*. 30–39, 1934.—It is found that the greatest improvement in hearing is given by an apparatus in which the intensity is independent of the frequency, especially in the region of low frequencies. For simple cases of deafness a circuit containing a microphone, telephone and dry battery are used and the results are only limited by the microphone characteristics. For defects in the labyrinth, it is essential to use the very best apparatus, including a sensitive carbon microphone and a valve amplifier. H. M. B.

1671. Amplification of Small Bells. A. N. Curtiss and G. M. Giannini. *Acoustical Soc. of America, J*. 5. *pp*. 213–217, *Jan*., 1934.—A set of 16 small bells was procured varying in height from 15" to 3", and these were tested as to their range or carrying power when supplied with suitable amplification. The authors conclude that small bells with proper amplification seem to be much more desirable, for several reasons, for use in carillons than the large heavy bells used at present. G. E. A.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts 1406, 1747.

CONDUCTION AND DISCHARGE IN GASES.

1672. Temperature of the Mercury Arc. W. Elenbaas. *Physica,* 1. *pp.* 211–224, *Jan.*, 1934. *In English.*—A discharge tube (inner dia. 20 mm.) is filled with a known quantity of mercury, so that for an input of 43·8 W (a.c.) pro cm. length, the pressure is just one atmosphere. This follows from the fact that the glass, which becomes soft at that input, is kept in place by the balance of the outer and the inner pressure. In this way the mean density and the pressure are known, so that, accepting a plausible cylindrical temperature-distribution in the tube, the temperature may be derived from these data. No use is made of the input and of the absolute value of the coefficient of conduction of heat. It is only assumed that this coefficient is proportional to T^4. In the centre of the contracted discharge a temperature of 6000°±800° K. is found (5·5 ampere 8·8 V/cm).
Author.

1673. Probe Measurements in the Positive Column in Inert Gases. K. Sommermeyer. *Zeits. f. Physik,* 87. 11–12. *pp.* 741–743, *Feb.* 19, 1934.—The experiments of Seeliger and Hirchert [see Abstract 1723 (1932)] are repeated for the purpose of investigating the effect of the length of the probe upon the characteristics obtained in the positive column in inert gases. It is found that a dependence of the slope or shape of the characteristic upon the probe length can only occur if the probe potential is measured relative to the kathode, but not if the probe potential is measured relative to the anode. No dependence of characteristic upon probe length is observable under conditions of discharge in which there is no occurrence of mobile layers in the positive column. The influence of probe length is thus shown to be due to the presence of these mobile layers [see Abstract 701 (1933)] and not to disturbances of the Maxwell distribution of the electrons.
L. A. W.

1674. Kathodic Sputtering of Metals. R. K. Cowsik. *Indian Journ. Phys.* 8. *pp.* 209–229, *Dec.* 15, 1933.—A discharge tube with detachable electrodes of Au, Ag, Sn, Ni, Mo and Al for use with a.c. from a transformer is described. Pt, Pd, and W are investigated in the form of wires. The amount of kathodic sputtering varies with the different metals; it is found to be proportional to the area of the kathode but to be independent of its mass or thickness. The possible effects of gas pressure and the temperature of the kathode are considered in the light of the thermal theory of Waran [see Abstract 2400 (1931)]. The theory is extended and a relation between rate of sputtering and the total heat of vaporisation of the metal is established.
F. C. C.

1675. Preparation of Sputtered Metal Films. E. O. Hulburt. *Rev. Sci. Instruments,* 5. *pp.* 85–88, *Feb.*, 1934.—The technique of sputtering is described. Opaque, optically good films were sputtered in a residual atmosphere of air from kathodes of Sb, Bi, Cd, Au, Pb, Pt, Ag, Sn and Zn in about an hour; from Co, Cu, Ir, Fe, Ni, Se and Te in two hours or so; and from Mo, Ta and W in several hours. Al, Be, C, Cr, Mg and Si sputter very slowly in air. In a residual atmosphere of Hg or He or A, opaque films of Al, Cr and Si were sputtered in a few hours. Evidence is presented which indicates that a majority of the sputtered particles are of molecular or atomic dimensions. The transmission of films of Pt, Ta and Cr was nearly constant for wave-lengths from 0·5 to 2·2μ; films of Si and C were relatively transparent from 1·0 to 2·2μ. AUTHOR.

1676. Slow Ions and Neutral Rays. A. Rostagni. *Zeits. f. Physik*, 88. 1–2. *pp.* 55–75, *Feb.* 21, 1934.—At grazing incidence ionic rays that impinge on a metal wall are not appreciably neutralised (between 100 and 600 volts in the case of A^+, H_2^+). The neutralising cross-section of ions in their own gases is independent of velocity at low velocities (6 to 600 volts in the case of A^+, Ne^+, He^+). Besides establishing these results the author obtains velocity curves for the release coefficients k and k' of electrons from metallic surfaces for ions and neutral rays. He finds that k and k' are of the same order of magnitude above 100 volts and both decrease with the velocity; that k appears to approach a constant limiting value of several hundredths at zero velocity, whereas k' becomes less than 10^{-4} even at 20 volts; and that the limiting values of k appear to be related in a simple manner to the corresponding values of the neutralisation energy. H. L. B.

1677. Ionisation by Collision in Helium. J. S. Townsend and S. P. MacCallum. *Phil. Mag.* 17. *pp.* 678–698, *March*, 1934.—In a previous paper [see Abstract 579 (1929)] an account was given of experiments made to determine the coefficients of ionisation of electrons and positive ions in pure neon. Similar experiments have now been made with the same apparatus filled with pure helium. The results obtained for the currents between the parallel plate electrodes for a given potential gradient and gas pressure, when electrons were set free by the action of ultra-violet light, bore a close resemblance to the results for neon under similar conditions. The results for both gases are in good agreement with Townsend's original theory of ionisation by collisions. The results are fully discussed theoretically. A. W.

1678. Positive and Neutral Rays. Part I. Neutralisation of Positive Rays. A. Rostagni. *N. Cimento*, 11. *pp.* 34–47, *Jan.*, 1934.—An experimental arrangement is described for measurements with positive and slow neutral rays. The results are given of measurements relative to the neutralisation of the ions at metallic surfaces and in gases at different velocities. On the striking or grazing incidence of A on a wall of Cu at velocities between 100 and 600 volts the percentage of particles neutralised is negligible compared with that which arises in the course of a few cm. of gas at pressure $< 10^{-5}$ mm. Hg. The efficacious section of the gases A, Ne, He, H, for the neutralisation of the respective ions is practically independent of the velocity of these between 400 volts and 6 volts. Measurements indicate that the ionisation of the gases A and Ne by collision with A^+ ions takes place starting from a velocity between 50 volts and 100 volts. J. J. S.

1679. Field Combinations for Velocity and Mass Spectrography. W. Henneberg. *Ann. d. Physik*, 19. 3. *pp.* 335–344, *Feb.*, 1934.—The orbits of charged particles in a combination of a homogeneous magnetic field and the electric field of a cylindrical condenser are investigated with reference to focussing, dispersion and mass separation. A hitherto unconsidered special case is found in which particular advantage can be taken of the velocity dispersion. The possibility of applying the apparatus to

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mass spectrography is discussed. The cases of focussing in a purely magnetic field, a purely electric field and Wien's method of compensated beams are contained in the calculations as special cases. J. E. K.

1680. Magnetic Electron Microscope. E. Ruska. *Zeits. f. Physik*, 87. 9–10. *pp.* 580–602, *Feb.* 3, 1934.—An account is given of an improved form of electron microscope. A new type of object support and a double objective magnetic " lens " is described. The possibilities of improvement in design are discussed. The performance of the apparatus is described with special regard to the resolving power, aperture and image formation. A series of photographs of thin aluminium foil taken with the apparatus are shown; the magnification varies from 7800 to 12,200 diameters (calculated). The definition is fairly good and the calculated resolving power is given as 4×10^{-7} cm. H. J. H. S.

1681. Action of Condensed Spark on Mixtures of Carbon Monoxide and Hydrogen. H. Lefebvre and M. van Overbèke. *Comptes Rendus*, 198. *pp.* 736–738, *Feb.* 19, 1934.—With the same method [see Abstract 3486 (1932)] the condensed spark causes very little change in mixtures of CO and H_2 containing 20–80 % of either, at pressures $\ngtr$ 9 mm. Hg (only formation of very little C_2H_4 and a trace of C_2H_2), unless the products of reaction are immediately removed, *e.g.*, by connecting the reaction tube with one cooled by liquid air. Pressure then decreases, and ultimately only CO or H_2 remains, the two having interacted as far as possible with formation of H_2O, CO_2, and C_2H_2, the ratio $CO_2 : C_2H_2$ increasing with initial pressure of CO. C. A. S.

1682. Dependence of Ionisation Current on Pressure. P. Kraus. *Zeits. f. Physik*, 88. 1–2. *pp.* 99–102, Feb. 21, 1934.—When the gas pressure is varied in a high pressure ionisation chamber, the alteration in the capacity owing to the change in the dielectric constant of the gas, contributes to the change in the ionisation current. A bridge method is used to determine the change in the capacity. Three curves of capacity against pressure are obtained, one for the steel bomb used by Regener [see Abstract 2533 (1932)] and containing CO_2 at 18·6° C. and the others with a smaller pressure chamber at 20° C. and 4° C. The results agree approximately with those to be expected from the Clausius-Mossotti formula, deviations being attributed to the behaviour of the amber insulator of the electrode. Owing to the unpredictable behaviour of these insulators each pressure ionisation chamber requires separate calibration. The effect of actual change of size of the steel bomb on the change in ionisation current is less than 0·1 % for pressures lower than 35 atmospheres. F. C. C.

1683. Investigation of Corpuscular Rays with a Double Ionisation Chamber and a Double Valve Electrometer. G. Stetter and J. Schintlmeister. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 9–10. *pp.* 427–436, 1934.—An arrangement of a double ionisation chamber connected to a double valve electrometer is described, by means of which the nature of corpuscular rays of any remaining range may be determined. The rays pass successively through a shallow anterior chamber and a deeper posterior chamber, the two chambers being separated by a thin metal foil. Ionisation may be produced in both simultaneously, but as it is registered separately the specific ionisation in each can be determined independently. The apparatus was tested with a bundle of α-particles and with natural H-particles. The separation of ejected H-particles and reflected α-particles when N_2 is under α-ray bombardment is then demonstrated and it is shown that the separation remains sharp when the angular aperture is increased to 30°. A 3-dimensional statistical diagram gives immediately without calculation a survey of the groups of rays present. The possibility of applying the method to simultaneous disintegrations is indicated. F. C. C.

1684. Time Curve of the Discharge in an Ionisation Chamber on the Passage of a Single Ionising Corpuscle. G. Stetter. *Akad. Wiss. Wien. Ber.* 142. *2a.* 9–10. *pp.* 471–480, 1933.—The time curve of the discharge in an ionisation chamber corresponding to the passage of a single ionising corpuscle is derived for a plane electrode. The results are expressed graphically. The ions produce an induced charge on the collector, the effect of which is of considerable importance when certain forms of amplification are used. The effect should also be considered when ionic mobilities are being determined. F. C. C.

1685. Choice of Grid Resistance in the First Stage of a Highly Sensitive Amplifier. G. Stetter. *Akad. Wiss. Wien, Ber.* 142. *2a.* 9–10. *pp.* 481–484, 1933.—The differences in potential which arise in a conductor owing to the thermal fluctuations of the electrons [see Abstract 2811 (1928)] are shown if the conductor is connected to a highly sensitive amplifier. The grid resistance of the first valve which is mainly responsible for the effect which occurs naturally in amplifiers, is, however, connected to the grid through a capacity; the higher frequency components of the oscillations produced by the thermal effects are, therefore. suppressed. The observed effect is then not proportional to $R^{\frac{1}{2}}$ as indicated by simple theory; the exponent is actually considerably less and with high resistances the effect becomes proportional to $R^{-\frac{1}{2}}$. F. C. C.

1686. Choice of Coupling Elements in the Construction of Amplifiers of Small Time Constant. G. Ortner and G. Stetter. *Akad. Wiss. Wien, Ber.* 142. *2a.* 9–10. *pp.* 485–491, 1933.—The time constants of amplifiers used in the registration of corpuscular rays should be small. The best values for the coupling elements are calculated and it is found more advantageous to have the smallest time constants at the commencement of the amplifier in two successive stages of equal amount. Graphs are given from which the proportionality error in the amplification may be determined for any given set of coupling data. A galvanometer of small period, such as a loop oscillograph should be used as registering instrument. F. C. C.

See also Abstracts 1385, 1461, 1724, 1758.

CONDUCTION IN SOLIDS AND LIQUIDS.

1687. Bloch's Theory of Conduction. E. Kretschmann. *Zeits. f. Physik,* 87. 7–8. *pp.* 518–534, *Jan.* 26, 1934.—A mathematical paper in which the mechanism of resistance proposed by Bloch [see Abstract 1449 (1929)] is shown to fail for all metals at medium temperatures, because of its dependence upon the resonance between elastic oscillations and material waves of the electrons. This cannot occur, since the conduction electrons must, to produce the observed resistance change their condition throughout very frequently, to be in agreement with the known resonance. Bloch's conclusion that "strongly bound" electrons receive another acceleration from the external field as if they were quite free is shown to be incorrect. The unaccelerated motion of a wave packet into the undisturbed crystal lattice at null field is attached to a definite condition. R. L.

1688. Electron Theory of Liquid Metals. S. Schubin. *Phys. Zeits. d. Sowjetunion*, 5. 1. *pp.* 81–105, 1934. *In English.*—Various questions connected with the theory of conductivity electrons in liquid metals are discussed. It is shown that an electron in the field of a non-periodic, almost homogeneous potential behaves almost like a " free electron." The behaviour of such an electron in a constant and an alternating field is investigated and the problem of the interaction of conductivity electrons with the thermally agitated ions is discussed. It is proved that if the thermal movements of the ions in a fluid could be considered as small oscillations about the positions of stable equilibrium, the usual law, R=A.T, would follow for the specific resistance at high temperatures. The existence of a residual resistance, independent of temperature, in the resistance curve of liquid metals may be explained by the occurrence of a great number of iso-energetic states in fluids, in consequence of which the direct scattering of electrons on ions appears possible. H. L. B.

1689. Conductivity at Low Temperatures. S. V. Vonsovsky and A. A. Smirnow. *Phys. Zeits. d. Sowjetunion*, 5. 6. *pp.* 115–130, 1934. *In English.*—Mathematical paper applying the general scheme of calculation of resistance, proposed by Bloch [see Abstract 1449 (1929)], and carried out by Nordheim [see Abstract 3907 (1931)] for the case of practically free electrons, to the case of bound electrons for the simplest known model of a metal, namely that of Kronig and Penney [see Abstract 2174 (1931)]. It is found that several assumptions made in the common theory are not permissible and that the denial of these changes essentially the known part of the physical conclusions drawn from them. It is shown that the probability of the transfer of an electron under the influence of collisions with the lattice from a state characterised by the quantum number k to a state k' contains, apart from the usual term proportional to $(k-k')^2$, terms proportional to the modulus $|k-k'|$ and terms entirely independent of $(k-k')$. These corrections, which do not follow from any specific form of the Kronig-Penney model, change essentially the relation between resistance and temperature at low temperatures giving a formula of the form $C_1T^5+C_2T^4+C_3T^3$, instead of the simple T^5 law. R. L.

1690. Theory of Alloys in the γ-Phase. H. Jones. *Roy. Soc., Proc.* 144. *pp.* 225–234, *March* 1, 1934.—The zones of allowed energies for the loosely bound electrons in alloys with the γ-structure are examined. It is shown that the lowest group of energy levels is almost completely filled by the number of loosely bound electrons given by the Hume-Rothery rule, and a reason for the existence of this rule is discussed. In addition it is shown that large diamagnetic susceptibilities may be expected for alloys in this phase, and that the Hall coefficient should change from large positive to large negative values as the composition varies through the phase in the direction of increasing number of loosely bound electrons.

AUTHOR.

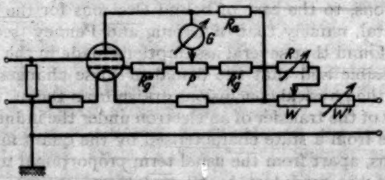
1691. Measurement of Alternating Potentials with a Duant Electrometer. C. Michel. *Zeits. f. Physik*, 87. 11–12. *pp.* 706–717, *Feb.* 19, 1934.—A method is described for using a Duant electrometer for the measurement of h.f. alternating potentials. The method relies upon the use of a special circuit which ensures that the needle potential oscillates with the same frequency as the potential to be measured and is in phase with it. A.c. with a frequency of up to 10^6 can be dealt with to within 0·1 mV. [See following Abstract.] J. E. R. C.

1692. Measurement of Alternating Potentials with a Duant Electrometer. A. Herrmann. *Zeits. f. Physik,* 87. 11–12. *pp.* 718–725, *Feb.* 19, 1934.—The theory is given of a method used by Michel [see preceding Abstract] for measuring h.f. alternating potentials by means of a Duant electrometer. J. E. R. C.

1693. Capacity Potential Divider. J. E. Richardson. *Journ. Sci. Instruments,* 11. *pp.* 82–85, *March,* 1934.—The construction and properties of a capacity potential divider are given in detail. It is intended for use up to frequencies of 10^6 ∼ and pressures of 60,000 volts. AUTHOR.

1694. Valves for D.C. Amplification. H. Saini. *Arch. des Sciences,* 15. *pp.* 495–500, *Nov.–Dec.,* 1933.—The condition is derived which valves must fulfil when used in Soller's circuit for the amplification of photoelectric currents [see Abstract 5291 (1932)] if the circuit is to be independent of variations in battery voltage, and the results of tests on several makes of valve given. Details (resistance values, etc.) of a circuit used for a particular purpose, and of its performance, are given. D. H. F.

1695. Valve Galvanometer. G. Barth. *Zeits. f. Physik,* 87. 5–6. *pp.* 399–408, *Jan.* 15, 1934.—This method, which may be considered as a development of one described by Soller [see Abstract 4223 (1933)] employs a double grid valve, and depends on the use of a properly arranged set of resistances to bring about balance. The circuit (see figure) uses a single source of e.m.f. to supply filament current and also the necessary voltages to the plate and auxiliary grid. It is shown mathematically that for certain values of the resistance the anode current and characteristics of the valve are independent of small variations in the supply voltage. G. E. B.



1696. Loading of Normal Resistances in Petroleum and Air. H. v. Steinwehr. *Zeits. f. Instrumentenk.* 54. *pp.* 48–51, *Feb.,* 1934. *From the Reichsanstalt.*—It is often necessary that the normal resistance in air or petroleum shall not undergo excessive changes when current is flowing and, in practice, construction has been arranged differently for the cases of short or long period loading, slow heating being aimed at in one case and a maximum of cooling surface in the other. To investigate these changes measurements of resistance were made with a Wheatstone bridge apparatus of the changes of resistance with temperature for resistances of 100, 10, 1 and 0·1 Ω. Values of the resistance coefficients α and β were deduced for selected temperature ranges. From the tabulated results and diagrams it is shown to be possible to choose α and β to satisfy selected conditions. When it is desired that the resistance shall be a maximum at 40° C. and the deviation of resistance not $>$ 0·01 % the values are $\alpha=1\times10^{-5}$ and $\beta=-0{\cdot}25\times10^{-6}$. The deviation does not then exceed 0·01 % over the range 11·7° to 68·3° C. and the wire can then be used for measurements with heavy loads in air with an error not $>$ 0·01 %. R. S. R.

1697. H.F. Resistance. P. Wenk and M. Wien. *Phys. Zeits.* 35. *pp.* 145–147, *Feb.* 15, 1934.—Resistances for h.f. circuits must have small self-inductance and capacity, no skin effect and so forth. To obtain this a Ag-Pt alloy is sputtered on to a carrier of special porcelain in an atmosphere of nitrogen. The carrier is a cylinder 42 mm. long with caps of copper at the ends. For high resistances the alloy is deposited in the form of a spiral. The resistances are protected by coats of cement or porcelain, and their value may be slightly changed by heating if this is required. Small resistance boxes can be made with several of these resistances in series, capable of being shorted by copper bars of equal inductance and capacity. H. M. B.

1698. Spreading of Electromagnetic Waves in a Supra-Conductor. W. Braunbek. *Zeits. f. Physik,* 87. 7–8. *pp.* 470–483, *Jan.* 26, 1934.—By making the specific resistance zero in the classical electron theory of metallic optics the complex refractive index of a supraconductor for electro-magnetic waves is obtained. From this it is found that below a limiting frequency ω_0 this refractive index is purely imaginary, which accords with an experimental decrease of the field magnitude in the direction of propagation of the " wave," and exhibits an optical analogy to the tunnel effect of matter waves. Above this limiting frequency the refractive index is purely real ; the wave proceeds undamped through the supra-conductor. The limiting frequency is yet apparently so high that this second possibility lies outside the region of validity of the classical theory. With consideration of limiting conditions the progress of an advancing wave through a thin supraconducting layer is calculated as well as the penetration of a stationary wave into a space surrounded on all sides by a thin supraconducting layer. It is shown how from an experiment in this direction at least a lower limit can be deduced for the number of the electrons distributed in a supraconductor. J. J. S.

1699. Hypothesis of a Critical Field in Supraconductivity. D. R. Inglis. *Frank. Inst., J.* 217. *pp.* 227–228, *Feb.,* 1934.—The possible existence of a critical strength of the magnetic field for supraconductivity is discussed. Reference is made to recent tests of this hypothesis of Silsbee by Tuyn and K. Onnes and by v. Laue. J. J. S.

1700. Conductivity of Metallic Films in an Electric Field. E. Perucca. *Comptes Rendus,* 198. *pp.* 456–458, *Jan.* 29, 1934.—The possible variation of the conductivity of a very thin film, the surface of which is electrostatically charged by an external electric field normal to the surface is investigated for different values of the external field. Using gold or platinum films deposited by kathode projection on quartz thread, the conductivity of the film for various thicknesses and the variation of resistance, at constant thickness, for different fields were measured. It was found that for stronger fields the conductivity of the film increased, this corresponding to a fall of resistance of the order of 40 % for a field of 4000 volts. N. M. B.

1701. Conductivity of Thin Metal Sheets. A. Jagersberger. *Zeits. f. Physik,* 87. 7–8. *pp.* 513–517, *Jan.* 26, 1934.—The possibility is discussed of calculating the decrease of the number of free electrons per $cm.^3$ with the thickness of sheet, from the deviation between the theoretical expression for the dependence of the free path of conducting electrons in metals and the experimentally determined relation between specific resistance and sheet thickness by utilising the formula for the specific resistance derived from both the classical theory and the wave mechanical theory of conduction. If it is remembered that a change in the number of free electrons per cm.^{3} is actually found in the thickness of sheet of the order of magnitude of the free path, it appears to be impossible to make a valid expression for the free path whose change with sheet thickness will depend solely on the relation between the specific resistance and the thickness itself. R. L.

1702. Electrical Conductivity of Cu-Pd Alloys at Low Temperatures, with an Additional Note on Cu_3Pt. H. J. Seeman. *Zeits. f. Physik*, 88. 1–2. *pp.* 14–24, *Feb.* 21, 1934.—Continuing previous investigations upon Cu_3Au, Cu_3Pd and Cu_3Pt alloys [see Abstract 4631 (1933)], measurement are made at room temperature and at the temperatures of liquid nitrogen and hydrogen upon six Cu-Pd alloys (Pd content ranging from about 38 to 53 atomic %), both in the state of irregular atomic distribution (specimen quenched) and of regular atomic distribution (specimen tempered). At the low temperatures it is found that the resistance is always about the same for both quenched and tempered states, though the latter has the lower value. At room-temperature, on the other hand, the specific resistance of a tempered specimen is several times less than that of a quenched specimen. The bearing of the results on the question of the constitution of the mixed Cu-Pd phases is discussed. In an appended note, previous measurements in the Cu_3Pt region are completed by the publication of additional experimental data upon an alloy containing 22·9 atomic % of Pt. L. A. W.

1703. Electrical Conductivity of Aqueous NaOH and KOH Solutions and the Limiting Mobility of OH^1 at 25°. G. H. Jeffery and A. I. Vogel. *Phil. Mag.* 17. *pp.* 582–584, *March*, 1934.—The author's values for the electrical conductivities of aqueous solutions of NaOH and KOH [see Abstract 2011 (1933)] are corrected, employing values of the primary and secondary dissociation constants of CO_2 determined by McInnes and Belcher, *viz.*, $K_1 = 4 \cdot 54 \times 10^{-7}$; $K_2 = 5 \cdot 61 \times 10^{-11}$, in place of those previously employed, *viz.*, $K_1 = 3 \cdot 50 \times 10^{-7}$; $K_2 = 4 \cdot 1 \times 10^{-11}$. The revised values are in better agreement with those of Gorowecka and Hlasko. J. S. G. T.

See also Abstracts 1649, 1654, 1708.

DIELECTRICS AND CAPACITANCE.

1704. Mathematical Treatment of the Electrostatic Field in Dielectrics. W. Wessel *Phys. Zeits.* 35. *pp.* 181–184, *March* 1, 1934.—A mathematical paper describing a method of solving the electrostatic field by considering the problem directly as an integral equation, instead of by solution of Laplace's equation and inserting appropriate boundary conditions. A general solution is obtained and applied to the problems of a point charge in air over a semi-infinite slab of dielectric, a dielectric sphere in a homogeneous field, a cylindrical condenser, cable with concentric dielectric layers, etc. R. L.

1705. Law of Corresponding States for Solutions of Dipole Substances. A. E. van Arkel and J. L. Snoek. *Phys. Zeits.* 35. *pp.* 187–196, *March* 1, 1934.—The dependence of the molecular polarisation on concentration, temperature, and pressure is found to be expressed by a formula which only contains the moment per unit volume and the temperature as parameter. For corresponding states, therefore, the same behaviour is always found, and this has been confirmed by data from the

following substances: nitromethane, nitrobenzene, ethyl nitrite, amyl nitrite, fluorbenzene, chlorobenzene, bromobenzene, iodobenzene, ethyl bromide, ethyl iodide, *n*-butyl chloride, *n*-butyl bromide, *n*-butyl iodide, tertiary butyl chloride, allyl chloride, triphenylmethylchloride, *n*-heptyl bromide, ethyl formate, ethyl acetate, ethyl propionate, methyl benzoate, ethyl benzoate, quinoline. A formula is also given for mixtures of two dipolar substances. The group of substances which obeys the law is thereby characterised in that it is not associated and only carries a partial moment. The behaviours of such substances as acetonitrile, and the monochloro-dichloro- and trichloro-acetonitriles which possess freely rotatable groups, and are moderately strongly associated, have also been examined, and the influence of the solvent indicated. For strongly associated liquids it has been found that 2 : 5- dimethylpyrazine, which is dipole-free, excels benzene in dissociating power, and has enabled the validity of the results for previous substances to be extended to the strongly associated compounds also. H. H. Ho.

1706. Dielectric Measurements with Dipole Liquids. J. L. Snoek. *Phys. Zeits.* 35. *pp.* 196–203, *March* 1, 1934.—Apparatus and methods of measurement are described for obtaining the dielectric constants and similar data for nitromethane, nitrobenzene, ethyl acetate, the system chlorobenzene-nitrobenzene, acetonitrile, mono-, di-, and tri-chloroacetonitrile, pyrazine, tetramethyl and 2 : 5- dimethyl-pyrazines, ethylene chloride, and ethylene bromide. H. H. Ho.

See also Abstract 1415.

ELECTROCHEMISTRY.

1707. Electrolytic Dissociation and the Raman Effect. Part II. Nitrates. I. R. Rao. *Roy. Soc., Proc.* 144. *pp.* 159–165, *March* 1, 1934.—Raman frequencies of nitrates in the crystalline state and in the state of solution are given. While in the former state the frequencies are different for different nitrates, in the latter they are identically the same. This is taken as an indication of the complete dissociation of nitrates in solution. Spectra with large concentrations of sodium and ammonium nitrates, taken with very long exposure, did not reveal even the slightest trace of any additional line due to undissociated molecules. Determination of the variation of intensity of the NO^-_3 line of sodium nitrate with concentration has shown that the ratio of intensity to concentration is constant, indicating the exact proportionality between number of NO^-_3 ions and concentration. It is therefore concluded that the study of the Raman effect leads to the hypothesis of complete dissociation of nitrates even at high concentrations. [For Part I see Abstract 321 (1931).] AUTHOR.

1708. Mobility of Chlorine and Hydrogen Ions in the Presence of Gelatin. S. A. Shchukarev and V. M. Vdovenko. *Phys. Zeits. d. Sowjetunion,* 4. 5–6. *pp.* 894–905, 1933. *In English.*—The specific electrical conductivity of solutions of 0·1*N* HCl with additions of gelatin was determined. The concentration of the gelatin was 0, 1, 3, 5, 8, and 10 %. The conductivity decreased owing to the binding of the very mobile hydrogen ions by the gelatin. The addition of gelatin increased the transference number of chlorine, partly by anomalously increasing the mobility of the chlorine ions. F. J. B.

1709. Tellurium Electrode. F. H. Getman. *Am. Electrochem. Soc., Trans.* 64. *pp.* 201–208; *Disc.,* 208, 1933.—The normal potential of the tellurium electrode, Te, Te^{++++}, was determined employing single crystals of tellurium as electrodes. A description of the method of casting single crystals of tellurium is given and the general crystallographic characteristics of the crystals is outlined. The manner of mounting such crystals for use as electrodes is described. The values of the e.m.f. of the cell Te, $TeCl_4$(m)2·5*N* HCl-KCl(sat'd)-Hg_2Cl_2-Hg at 25° C., for concentrations ranging from 0·0004 to 0·01 molar was measured. From the measured values of the e.m.f. of the foregoing cell, the normal electrode was calculated and found to be Te, Te^{++++}, $E_0 = -0{\cdot}5682$ V. AUTHOR.

1710. Metallised-Glass Hydrogen Electrodes. E. Newbery. *Am. Electrochem. Soc., Trans.* 64. *pp.* 209–220, 1933.—Ag, Au, Pt and Pd are easily plated on to glass tubing simply by dipping the glass into alcoholic solutions of their salts and heating. Pd electrodes made in this way may be used where Pd or Pt black is undesirable. The most satisfactory electrodes for general use are platinised Au or Pt on glass. Pd electrodes on glass are slow in action due to a strongly marked arrest in the time-potential curve but give reliable final values. They are liable to disintegrate after long use. Palladinised electrodes retain their hydrogen potential long after the H_2 supply is stopped and may be used for rough pH determinations in well buffered solutions, without external H_2 supply, by kathodic charging before use. Silvered glass electrodes are not reliable for H_2 electrode work but may be used as O_2 or air electrodes in alkali or as silver chloride electrodes after anodic treatment in HCl. All H_2 electrodes require longer time for attaining equilibrium in alkali than in acid. R. L.

1711. Overvoltage. A. L. Ferguson and G. Dubpernell. *Am. Electrochem. Soc., Trans.* 64. *pp.* 221–247; *Disc.*, 247–248, 1933.—Review of published work indicates that there is no relation between the solubility of hydrogen in metals (such as platinum, copper, iron, etc.) and the diffusion of the gas, particularly when produced by electrode polarisation, through the same metals. Current density-voltage curves have been determined for the back and front of platinum electrodes, 0·0015–0·0001 in. thick, in dilute H_2SO_4, both with and without hydrogen and oxygen bubbling round the electrodes. The results show that the electrolytically liberated gases do not diffuse through solid metal and that reports to the contrary arise from the use of defective electrodes. The principal evidence for this view is that (*a*) the kathode and anode effects are completely analogous; (*b*) if the metallic films are handled with care, total impermeability may be observed; (*c*) sudden large increases occur in the potential at the back of the electrode; (*d*) rapid depolarisation of the back of the electrode occurs frequently; and (*e*) a change of potential at the front is often accompanied by an immediate change at the back. A similar result was obtained in less detailed experiments with palladium; it is probable that in this case the first absorption of hydrogen by the metal opens up existing surface cracks and produces openings through the film. H. F. G.

1712. Graphite Anodes in Electrolysis of Aluminium Oxide. M. deK. Thompson and R. G. Seyl. *Am. Electrochem. Soc., Trans.* 64. *pp.* 321–327, 1933.—The decomposition voltages of Al_2O_3 are calculated by the third heat theorem for unattackable anodes and for graphite anodes at 1000° and at 1300° C. The difference between the decomposition voltages for the two kinds of electrodes at a given temperature is the theoretical depolarisation. The depolarisation is also calculated as the e.m.f. of the cell:—O_2 (at pressure in equilibrium with C)/any electrolyte with oxygen ions/O_2 (1 atmosphere)—and the two methods check to 0·01 V. The decomposition voltages are measured with a Pt anode and with graphite anodes at temperatures between 971° and 1231° C. The decomposition voltage decreases linearly as the temperature rises. Depolarisation is not complete at any temperature, and there is practically no overvoltage with a Pt anode. AUTHORS.

1713. Potentials of Lead Oxide Electrodes in Alkaline Solution. L. V. Andrews and D. J. Brown. *Am. Chem. Soc., J.* 56. *pp.* 388–390, *Feb.*, 1934.—Since lead peroxide in contact with an alkaline solution of lead oxide reacts to form Pb_3O_4, a standard potential with the monoxide and dioxide in the alkaline half-cell has been obtained using Pb_3O_4 as the intermediate product and calculating the oxidation potential. The results are: $PbO-Pb_3O_4-OH$, $+0{\cdot}2488\pm0{\cdot}0005$ volt; $Pb_3O_4-PbO_2-OH$, $0{\cdot}1295\pm0{\cdot}001$ volt; $PbO-PbO_2-OH$, $0{\cdot}280\pm0{\cdot}001$ volt. Free energy changes, calculated from the measured values of the cells, are given. N. M. B.

1714. Theory of Glass Electrodes. P. Gross and O. Halpern. *J. Chem. Phys.* 2. *pp.* 136–140, *March*, 1934.—A glass electrode is considered schematically to be a difficultly soluble electrolyte which absorbs water and further salts present in an adjacent solution. The potential is the distribution potential at the boundary surface between the glass and the solution. According to the theory presented this potential varies if certain reasonable assumptions are made concerning the value of the constants occurring (dissociation constants in the glass, distribution constants between glass and water) over a wide range of concentration in acid and neutral solutions in the same manner as that at an H_2 electrode. The variation of the potential differs from the latter in a strongly alkaline solution, in the manner ascertained experimentally and predicted in previous communications. The extremely simplified model describes quantitatively with one empirical constant the potentials hitherto observed. It is shown that the systems are completely explicable on the basis of the usual thermodynamic picture of equilibrium. Attempts on the other hand to describe the phenomena on the basis of diffusion potentials have not led to satisfactory results. AUTHORS.

1715. Optical Observations on the Passivity of Iron and Steel. L. Tronstad and C. W. Borgmann. *Faraday Soc., Trans.* 30. *pp.* 349–361, *March*, 1934.—Mirrors of iron and both ordinary and stainless steel were measured during the period of immersion in concentrated nitric acid, 0·01 *M* chromium trioxide CrO_3 and 1 *M* K_2CrO_4, by means of the optical method of Drude. The results indicated that the natural films were somewhat strengthened or even replaced by denser films in full accordance with the oxide theory of passivity. On " austenitic " stainless steel in concentrated nitric acid the protective films were thinner than those formed by anodic treatment. They were about 10 Å in thickness, which is nearly the thickness of the natural oxide film on iron in dry air. [See Abstract 2103 (1933) and following Abstract.] F. J. B.

1716. Optical Observations on the Protective Films on Aluminium. L. Tronstad and T. Höverstad. *Faraday Soc., Trans.* 30. *pp.* 362–366, *March*, 1934.—The methods of optical examination of protective film on iron [see preceding Abstract] were applied to aluminium. It was found that the optical properties of the natural oxide film on aluminium underwent only slight changes in solutions of chromic acid and chromate-chloride solutions. The films were not protective in concentrated sulphuric acid. In concentrated nitric acid an alternative formation and breakdown of the protective film seemed to occur. The films were much thicker than the natural oxide films on iron and steel, and were about 100 Å thick. F. J. B.

1717. Influence of Electric Field on Potential at a Metal-Solution Interface. H. K. McClain and H. V. Tartar. *J. Phys. Chem.* 38. *pp.* 161–170, *Feb.*, 1934.—The effect of an electric field of moderate strength on the potentials of gold and platinum against several solutions has been determined. The results prove the validity of one fundamental assumption in the treatment of cataphoresis, namely, that the charge distribution in the double layer is unaffected by an applied field of the strength used in cataphoresis experiments. AUTHORS.

See also Abstracts 1475, 1703, 1750.

ELECTRONS, POSITRONS AND PROTONS.

1718. Annihilation of Positrons. J. Thibaud. *Comptes Rendus*, 198. *pp.* 562–564, *Feb.* 5, 1934.—In continuation of an earlier paper [see Abstract 1320 (1934)] the author quotes further evidence in favour of the hypothesis that a positron can coalesce with an electron with the simultaneous emission of γ-radiation of energy 5×10^5 e.V. J. E. R. C.

1719. Theory of Electron and Positron. W. H. Furry and J. R. Oppenheimer. *Phys. Rev.* 45. *pp.* 245–262, *Feb.* 15, 1934.—An interpretation of Dirac's theory is developed. Its physical interpretation is first discussed, with reference to limits imposed on the description of a system and in particular on the localisability of the electron. The corresponding formalism is then set up, introducing wave-functions to describe the state of electrons and positrons in the system, and constructing the required operators. The theory is Lorentz invariant and has also the required invariance under contact transformations. The electromagnetic interaction of electrons and positrons is formulated and discussed. Where directly applicable, the Dirac equation gives the correct energy levels for an electron and the correct radiation and collision transition probabilities. Applications outside the scope of the original Dirac theory are outlined: a part of the energy of an electromagnetic field is shown to reside in general in the electrons and positrons: and for two charges within a Compton wave-length of each other the law of force is not quite Coulomb's law; the latter may be detectable when protons are scattered in hydrogen. T. L. M.

1720. Production of Positrons. J. Chadwick, P. M. S. Blackett and G. P. S. Occhialini. *Roy. Soc., Proc.* 144. *pp.* 235–249, *March* 1, 1934.—The emission of positrons has been observed under different experimental conditions: (1) from a lead target exposed to the γ-rays of thorium active deposit; (2) directly from a source of thorium active deposit; and (3) from a lead target exposed to the radiations (γ-rays and neutrons) emitted by beryllium, boron, and fluorine when bombarded by polonium α-particles. The measurements of the energies of the positrons ejected from lead by the thorium γ-rays support the view that a positron and an electron are produced simultaneously by the interaction of a γ-ray and an atom, and that the mass of the positron is the same as that of the electron. The positron and electron are probably created in the electric field outside, rather than inside, the nucleus. The observations show that when γ-rays of high frequency pass through lead an appreciable fraction (about one-fifth for a γ-ray of $h\nu=2\cdot 6\times 10^6$ volts) of the energy absorbed is used in this process of creating a positron and an electron.

AUTHORS.

1721. Intrinsic Energy of the Electron. G. Wataghin. *Zeits. f. Physik*, 88. 1–2. *pp.* 92–98, *Feb.* 21, 1934.—Purely mathematical. H. F. G.

1722. Inner Potential of Semi-Conductors. K. R. Dixit. *Phil. Mag.* 17. *pp.* 732–733, *March*, 1934.—A correction is made in the value of Φ for ZnS. This should be $2\cdot 6 \pm 1$ volts. [See Abstract 5445 (1933).]

1723. Emission of Electrons under the Influence of Chemical Action. Part II. A. K. Denisoff and O. W. Richardson. *Roy. Soc., Proc.* 144. *pp.* 46–75, *March*, 1934.—From the results of experiments on the reaction between K_2 Na and 22 different gases, the following conclusions are drawn. The energy distribution is not in general of the Maxwellian type. The distribution curves all rise from a small value at zero energy ($V = 0$) to a maximum at a certain energy ($V = V_m$) and fall to zero at a certain maximum energy ($V = E_e > V_m$). These curves have a "tail," like that in the photoelectric effect, and E_e is approached rather gradually. A practical maximum energy E_m is obtained by disregarding the tails. About 99·9 per cent of the electrons have energies below E_m ($E_e > E_m > V_m$). The distribution curves for energies $> V_m$ and $> E_m$ can all be represented quite closely by $N(V)dV = Ae^{-k(V-V_m)^c}dV$, A, k, and c being constants. For the most energetic reactions this equation holds approximately from $V = 0$ to $V = E_m$. For the chlorine compounds $E_m + P =$ constant, where P is the dissociation energy of the relevant reaction. At very low pressure the electron emission is proportional to the pressure, usually rising to a sharp maximum at a quite low pressure and then falling. The yield of electrons diminishes rapidly as the available chemical energy diminishes. These facts are accounted for on the view that in the formation of the polar bond, which involves spontaneous rearrangement of the electronic system of the atoms concerned, the bond is stabilised spontaneously by a three-body collision with a free metallic electron which carries away all the reaction energy, the effect being thus a quantum phenomenon. This view gives a reasonable account of the energy distribution and allows of a simple interpretation of the equation, $E_m + P =$ const., which is $E_m = E_c - \phi$, where E_c is the energy of the corresponding elementary chemical reaction responsible for E_m, and ϕ the work function of the metal. This relation appears to be general and is similar to the fundamental law of photoelectricity. [See Abstract 3932 (1931).] T. H. P.

See also Abstracts 1388, 1397, 1404, 1405, 1457, 1485, 1541, 1542, 1579.

ELECTROSTATICS.

1724. Electrical Nature of Iron Sparks Emitted from a Grinding Wheel. U. Nakaya. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 483. *pp.* 185–201, *Feb.*, 1934. *In English.*—Particulars are given of the characters of the sparks emitted from various kinds of iron pressed against a grinding wheel. Positive and negative ions are emitted from the sparks. Positive ions are more abundant than negative ions at the middle part of the track; negative ions are more abundant at the end of the track. Values of e/m are deduced. J. S. G. T.

See also Abstracts 1691, 1692, 1700, 1704.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

1725. Theory of the Hall, Nernst, Ettingshausen and Righi-Leduc Effects. N. Akulov. *Zeits. f. Physik*, 87. 11–12. *pp.* 768–777, *Feb.* 19, 1934.—It is shown that the change of the thermoelectric force of ferromagnetic metals which arises from their magnetisation or stretching is conditioned by: (1) anisotropy of the crystals, and (2) change of direction of the resulting spins in the separate crystal regions. The law of anisotropy found earlier for magnetostriction is generalised for thermomagnetic and some other phenomena. By means of this generalisation, and the spin distribution function found by the author and Kondorski, is given the dependence of the various parameters relating to the thermomagnetic and thermoelastic characteristics of ferromagnetic metals on the intensity of magnetisation and on elastic tensions. J. J. S.

1726. Discontinuities of Resistance Associated with the Barkhausen Effect. C. W. Heaps. *Phys. Rev.* 45. *pp.* 320–323, *March* 1, 1934.—A nickel wire, under bending stress, shows a large discontinuity of magnetisation. The resistance of such a wire has been examined with a sensitive Kelvin double bridge and a jump of magneto-resistance of magnitude $dR/R = 6{\cdot}35 \times 10^{-5}$ has been found associated with the magnetisation jump. The negative results of Steinberg and Miroschnischenko [see Abstract 4261 (1933)] are explained as being due to insufficient sensitivity of their apparatus. It is suggested that the resistance jump is due to small rotations of the saturated magnetisation of small elements of the material, these rotations being due to alterations of the Lorentz field by reversals of magnetisation in neighbouring elements. AUTHOR.

See also Abstracts 1696, 1699.

MAGNETISM AND ELECTROMAGNETISM.

1727. Magnetic Pole, A Useless Concept. F. W. Warburton. *Am. Phys. Teacher*, 2. *pp.* 1–6, *Feb.*, 1934.—The description of magnetism in terms of moving electric charges rather than in terms of magnetic poles reduces both the number of experimental laws upon which the theory is based and the number of new quantities defined. Certain sources of confusion are discussed and an elementary description is developed which permits a clearer visualisation of the process of magnetisation than does the pole theory and which is, in certain respects, less confusing. Emphasis is placed on the distinctions between the electric fields, E and D, and the magnetic fields, B and H, and their relative importance. The definitions are chosen so as to give each of these four quantities simple physical meaning. AUTHOR.

1728. Magneto-Resistance and Magnetic Structure of Ferromagnets. Giulia Alocco. *N. Cimento*, 10. *pp.* 355–371, *Nov.*, 1933.—The fundamental relations between the electric resistance and reversible processes of magnetisation in ferromagnets are utilised for putting in evidence a coordinated distribution of the single elementary moments in a polycrystalline material. The research, carried out with thin laminæ of nickel, leads to determining the true aspect of the effects of longitudinal and transversal magneto-resistance, showing how these remain in all cases akin to those in monocrystals, provided that, taking account of the refraction of the lines of force, we have regard to the orientation of the internal field and of the current measured with respect to particular directions of anisotropy. A. D.

1729. Theory of Residual Magnetism and of the Curve of Magnetisation. G. Gentile. *N. Cimento,* 11. *pp.* 20–33, *Jan.,* 1934.—A study is given of the resonance forces in the case of a large number of atoms. The consideration that a crystal may be treated as if divided into separate elementary zones simplifies the working out of the problem, since it leads to a function in which appear the total moments of the elementary zones. This method is particularly adapted to the study of the phenomena of residual magnetism and of the curve of magnetisation and furnishes the justification of Bloch's results. J. J. S.

1730. Magnetic Detection of Flaws in Metals. J. Peltier. *Comptes Rendus,* 198. *pp.* 556–557, *Feb.* 5, 1934.—In previous papers [see Abstract 2446 (1931)] a study has been made of the possibilities offered by the use of fixed or rotating magnetic fields for exploring machine shafts and other metal parts with a view to the detection of defects in homogeneity, blow holes, etc. With a view to avoiding the use of batteries an investigation was made of apparatus using indirectly heated valves supplied from 115-volt, 50-cycle a.c. mains. The first arrangements tried were insufficiently sensitive, but apparatus was finally evolved which, when used with a good galvanometer, was sufficiently sensitive and stable to detect variations of thickness of the order of 0·01 mm. in a steel plate of mean thickness about 8 mm. The apparatus gives satisfactory results when used on aluminium and its alloys, copper, brass, silver, etc. In the case of cables, it has been found advantageous to replace the induction balance by an arrangement rather like a Wheatstone bridge, fed by a.c. and operating on the grid circuit of the first valve of an amplifier, one of the bridge inductances being affected by the part under test, or even traversed by it. A. W.

1731. Crystal-Diamagnetism of Bismuth Crystals. A. Goetz and A. B. Focke. *Phys. Rev.* 45. *pp.* 170–199, *Feb.* 1, 1934.—The purpose of the investigation was to study the effect, on single Bi crystals, of atoms dissolved in the metallic crystal lattice. Magnetic measurements were made by the Gouy method for fields of range 2500 to 22,500, and for a temperature range from − 185° to + 271° C. The susceptibilities for the purest Bi at 21°C. are $\chi\perp = -1{\cdot}482 \times 10^{-6}$, and $\chi|| = -1{\cdot}053 \times 10^{-6}$. The values for alloyed crystals depend on the speed of growth for low speeds. The effect of the type of insertion of foreign admixtures on the crystal-diamagnetism is nil in the case of complete insolubility (Bi-Cu); it is random for macroscopic solubility (eutectic mixture) (Bi-Ag); and it is large and directional for atomic solubility, whether the admixture enters the crystal as an atom (Sn, Pb and probably Ge), or as an intermetallic compound (Bi-Se, Bi_2Te_3). For atomic solubility, the effect is smallest for an isomorphous mixture (Bi-Sb), and the effect of an admixture is larger, the smaller the solubility limit. The effect of the nature of the dissolved atom on the magnetic anisotropy is studied for the immediate neighbours of Bi in the periodic system; electropositive admixtures increase the anisotropy $\chi\perp/\chi|| = R$, whilst electronegative admixtures diminish it. The effect of temperature on anisotropy for high concentrations of electronegative mixtures can be so large that R becomes infinite; the crystal becomes paramagnetic in one direction and diamagnetic in the other. Many other points are dealt with. G. E. A.

1732. Paramagnetism. Part I. Mechanism of Quenching of Orbital Magnetic Moment in Paramagnetic Ions of the Iron Group. S. Datta. *Phil. Mag.* 17. *pp.* 585–602, *March,* 1934.—The magnetic moments of Co^{++} and Ni^{++} ions have been measured experimentally in different states of aggregation: (1) as hydrated salts; (2) coordination compounds; (3) as alcohol or HCl solutions of the chlorides over a temperature range from 90°–390° Abs. The magnetic moment is practically the same in powdered crystals of hydrated and anhydrous salts; it is lower in coordination compounds having a value approaching that calculated from the Bose-Stoner "spin only" formula. In (3) there is a break in the $(1/\chi) - T$ diagram indicating a change in moment with the change in colour. The spectroscopic behaviour of the solutions indicate the presence of solvated ions at low temperatures. The Bose-Stoner value is reached for Ni^{++} ions under certain conditions but never for Co^{++} ions. These behaviours are interpreted by theories propounded by Bose and Datta and by van Vleck to explain the quenching of orbital magnetic moments of ions of the iron group. W. R. A.

1733. Magnetic Fields with Symmetrical Arrangement of Coils. G. Fanselau. *Terr. Mag.* 38. *pp.* 277–282, *Dec.,* 1933. *In German.*—For production of the supplementary fields very frequently required in measurements connected with terrestrial magnetism the galvanic method is increasingly employed. To facilitate calculations and comparison of relative measurements tables for the fields of the coils are prepared. Some tables of this kind are given in the paper with explanations of their methods of use. J. J. S.

1734. Currents in Conductors and Associated Waves. G. Peretti. *Accad. Lincei, Atti,* 18. *pp.* 547–552, *Dec.* 17, 1933.—Since it is possible to associate the propagation of a wave with certain phenomena characterised by functions of positions in space and time, bound together by differential equations, such equations are used to determine the propagation of electromagnetic waves along a system of rectilinear parallel conductors. First, two conductors are considered as carrying the current in one direction while it can return along a single conductor. The solution is then extended to *n* parallel conductors. Special conditions and general cases are investigated. H. M. B.

1735. Magnetostriction of Ferromagnetic Ellipsoids. Part I. Theory. R. Becker. *Zeits. f. Physik,* 87. 9–10. *pp.* 547–559, *Feb.* 3, 1934.—The thermodynamical theory of magnetostriction is developed for an ellipsoidal body of given dimension ratio magnetised parallel to its axis of rotation. The influence of the demagnetising factor and its alteration with variation in the dimension ratio, together with the volume changes in, and above, the region of saturation are discussed. [See following Abstract.] H. J. H. S.

1736. Magnetostriction of Ferromagnetic Ellipsoids. Part II. Iron and Cobalt. M. Kornetzki. *Zeits. f. Physik,* 87. 9–10. *pp.* 560–579, *Feb.* 3, 1934.—The theoretical deductions given [see preceding Abstract] are examined experimentally. The relation between the linear magnetostriction and the dimension ratio is illustrated by measurements on 5 ellipsoids of pure iron with dimension ratios of 1, 2, 3, 4 and 5. The difference between the magnetostriction of an ellipsoid and an infinitely long rod magnetised to the same degree is deduced. The volume magnetostriction of specimens of pure and commercial iron of various dimension ratios is measured and it is shown that this depends on 3 factors for pure iron and 4 for commercial iron. These factors are discussed and explanations of them are offered. The linear magnetostriction of pure iron is measured in fields up to 7,000 G.; at 3500 G. there is an inversion point and in stronger fields the length increases. In binary alloys of the Fe-Ni-Co series the volume increases if the material is magnetised to saturation. A close agreement is observed between the experimental and theoretical results. H. J. H. S.

1737. Magnetic Properties of Iron and Steel on Extension. E. Lopuchin. *Phys. Zeits. d. Sowjetunion,* 5. 1. *pp.* 57–74, 1934. *In German.*—It is shown that an iron or steel rod, mounted vertically, becomes magnetised when stretched in an extensometer. The magnetisation is due to the action of the earth's field and when this is compensated the material remains unmagnetised. A method of estimating the elastic limit of the rod by measuring the magnetisation curve under load in the earth's field is described. For iron and mild steels the limits agree with those measured mechanically but for high carbon and alloy steels, in which the hysteresis is great, the results are neither reliable nor reproducible. H. J. H. S.

See also Abstracts 1448, 1457, 1459, 1460, 1518, 1649, 1658, 1690, 1698.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1738. A.C. Conductance and D.C. Excitation of Nerve. K. S. Cole. *Science,* 79. *pp.* 164–165, *Feb.* 16, 1934.—An attempt is made to correlate the a.c. properties of biological materials with the excitation of nerve tissues. Measurements over a wide range of frequencies show that such materials may be considered electrically as equivalent to a circuit containing two fixed resistances and a polarisation element with infinite impedance at zero frequency and zero impedance at infinite frequency. Calculations show that when the equivalent polarisation element has a constant phase angle and an impedance which is a power function of the frequency, then the p.d. across the element should build up as a power function of the time, after a constant current is started through it. It is assumed that the polarisation element is to be identified with the cell membrane and that a threshold charge of potential across the membrane will stimulate an excitable tissue. Complete experimental information on a.c. and d.c. properties of biological materials is not available, but the data to hand suggest that conductance and excitation phenomena involve the same polarisation element. J. E. R.

1739. Ultra-Short Electric Waves in Biology. G. M. McKinley. *Univ. Pittsburgh, Bull.* 30. *pp.* 183–188, *Nov.* 15, 1933.—A large number of experiments on the biological effects of h.f. oscillations, of the order of 10^5 kc. are described. The best known effect of the vibrations is the production of synthetic fevers in the animal body. Other phenomena investigated include the effects on the rate of germination of seeds, dissociation and size changes in bacteria and the actions on nervous and other tissues. There are strong indications of a specific action of the h.f. vibrations on nervous tissues, distinct from the usual heating effects. J. E. R.

1740. Heat Production in Diathermy Treatment. A. Hemingway. *Radiology,* 22. *pp.* 84–86, *Jan.,* 1934.—Details experimental results, obtained with the human patient, to determine the total amount of heat energy received by the patient and the rate at which this heat energy is received. The measurements were made by means of a thermoelectric h.f. voltmeter, connected in parallel with the patient and a h.f. ammeter in series with the patient. The results are discussed with reference to the necessary output of diathermy apparatus and suggestions are made as to possible applications, with respect to physiological investigations. B. J. L.

1741. X-Ray Planigraphy. B. G. Z. des Plantes. *J. de Radiologie et d'Électrologie*, 17. *pp.* 73–76, *Feb.*, 1934.—Briefly describes a method, in which, by taking successive exposures, as the X-ray tube is given a circular, or spiral, movement, the dimensions of an object, within a larger object, can be determined from the geometrical characteristics. The method has been developed by the author since 1921 as a result of the application of microscopical theory. B. J. L.

1742. Constant Ultra-Violet Output from Quartz Mercury-Arc Lamps. W. T. Anderson, Jr. *Rev. Sci. Instruments*, 5. *pp.* 127–129, *March*, 1934.—The chief difficulty in the use of quartz mercury-arc lamps as sources of ultra-violet radiations has been the decrease of total light output with usage. Recent developments of the Weston " photronic " cell have made accurate measurement of ultra-violet light possible. In the apparatus described the arc is operated initially to produce about 70 % of the maximum output, and activates a " photronic " cell covered with an ultra-violet filter. Any deviation in the reading of the micro-ammeter attached to the cell can be corrected by a slight increase of the wattage input to the arc. The micro-ammeter can be replaced by a series of relays which automatically correct any drop in the light output. J. E. R.

1743. X-Ray Dosage. R. Jaeger. *Zeits. f. techn. Physik*, 15. 1. *pp.* 39–42, 1934.—For monochromatic X-rays intensity is always proportional to energy. For heterogeneous radiation intensity and incident energy are proportional, also dosage and absorbed energy. The absorption of X-rays in body-tissues, which consist mainly of water, is almost the same as that in air, since the effective atomic number is nearly the same in each case. The measurement of X-ray dosage in the body is based on this fact. In the case of physical or chemical effects, however, where the effective atomic number of the substance irradiated is quite different from that of air, it is no longer possible to use measurements based on air-absorption. J. T.

1744. Changes in Electric Potentials and Rates of Oxidation of the Skin after X-Radiation. M. M. D. Williams and C. Sheard. *Radiology*, 22. *pp.* 41–48, *Jan.*, 1934.—The present experiments relating to the effect of X-rays on the skin, differ from the previous work in that the resulting erythema was not the subject of investigation, but the rates of oxygen consumption before and after irradiation. With a dose of 9000 R. given upon frog's skin, the consumption of oxygen and the electric potentials of the skin were shown to increase for 16 to 18 days, but these changes were not constant, although being analogous to the changes in respect to erythema. The values of the potential differences and of oxygen consumption gave similar types of curves when plotted, but the variations in the latter preceded those of the electric potential. Using a lethal dose of 160,000 R. the period of increased activity, was shortened and varied with the region of the skin, and the cyclic variation was not pronounced. B. J. L.

1745. Dosage for Long Radium or Radon Needles. Edith H. Quimby. *Am. J. of Roentgenology and Radium Therapy*, 31. *pp.* 74–90; *Disc.*, 90–91, *Jan.*, 1934.—The spatial distribution of the irradiation intensity in respect to radium and radon needles has been determined in respect to the necrosis of rabbit muscle, human erythema and butter bleaching, the results corresponding to ionisation measurements. Calculated and experimental data, in respect to the distribution of radiation, are shown to agree. It has been found that when a series of needles are placed in a plane parallel to one another and uniformly spaced, the addition of needles at one end of the series has very little effect on the dose of radiation delivered at the other end. Twenty erythema doses are required to produce complete necrosis in rabbit muscle. The question of spacing of the needles is investigated and suggestions made in respect to normal practice to the practical distribution of needles. B. J. L.

See also Abstracts 1624, 1632.

OSCILLATIONS.

1746. Stationary Waves Modified by Dielectric. O. Fagioli. *N. Cimento*, 10. *pp.* 383–392, *Dec.*, 1933.—The system of stationary waves which is established along Lecher-wires may be modified by a layer of dielectric, different from that of the surroundings, inserted perpendicularly to the wires. The modification depends not only on the thickness, but also on the position of the layer. This dependence is discussed theoretically and some results of experiment are also given. J. J. S.

1747. Calculus of Mechanical or Electrical Oscillations. J. Haag. *Comptes Rendus*, 198. *pp.* 693–695, *Feb.* 19, 1934.—A general method of dealing with both mechanical and electrical oscillations is given by using at the same time imaginary quantities and elementary tensors. By this means several general theorems concerning alternating currents can be demonstrated very easily. H. M. B.

See also Abstracts 1476, 1683, 1684, 1685, 1686, 1694, 1734.

PHOTOELECTRICITY.

1748. Photoelectric Effect in Coloured Rock-Salt. S. Pelz. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 9–10. *pp.* 509–522, 1933.—The crystal under investigation is provided with two electrodes, one earthed and the other connected to an electrometer, and is illuminated at right angles to the line joining the electrodes. By means of a movable opaque stop any desired region of the crystal may be darkened. With this arrangement it is shown that the crystal photo-effect (previously observed only with cuprite and diamond) also occurs with natural specimens of rock-salt and artificially prepared specimens of coloured NaCl and KCl. The observed e.m.f., V, is found to be proportional to $\log [(1 + a\mathrm{I})/(1 + a\mathrm{DI})]$, where I is the light intensity, D is the fraction of this intensity in the darkened region of the crystal, and a is a constant. The photoelectric current is found to be proportional to the product of V and I. Interruption of the incident beam by means of a sector rotating at speeds between 500 and 2000 r.p.m. shows no dependence of photo-effect upon speed of revolution. From these results it is concluded that the effect is due to the diffusion of photoelectrically liberated electrons from the illuminated part to the unilluminated part of the crystal. L. A. W.

1749. Negative Photoelectric Effect in Silver Bromide. R. G. Jensch. *Phys. Zeits. d. Sowjetunion*, 5. 1. *pp.* 75–80, 1934. *In German.*—Using an apparatus similar to that of Kirillow [see Abstracts 1519 (1929) and 2252 (1931)], the negative photo-effect in AgBr, which consists of a decrease of the electrical conductivity of a granular AgBr layer under the influence of light, is shown to be to a large extent reversible. In some cases complete reversibility is observed. These results are difficult to explain on the hypothesis of Toy [see Abstract 588 (1930)] according to which the photo-effect is due to a mechanical splitting up of the AgBr layer under the influence of illumination. L. A. W.

1750. Influence of Intensity of Light on Photovoltaic Phenomena. R. Audubert and Geneviève Lebrun. *Comptes Rendus*, 198. *pp.* 729–731, *Feb.* 19, 1934.—The relation $E = (RT/nF) \log (1 + aI)$, where a is a constant depending on the nature of the photosensitive substance, the liquid in contact therewith, and the temperature; I the intensity of the light; n the valency of the kation of the electrode; and R, T, and F have their usual meanings, is valid for Cu|CuO, Cu|Cu_2O, and other similar electrodes, provided that $n = 1$, whence it is inferred that the photolysis of water is according to $H_2O \rightarrow H^{\cdot} + (OH)'$ and not $H_2O \rightarrow H_2 + 1/2(O_2)$. [See Abstract 4247 (1933).] C. A. S.

1751. Semiconducting Photoelectric Cells in Meteorology. L. W. Pollak. *Gerlands Beitr. z. Geophys.* 41. 1. *pp.* 92–102, 1934.—The use of these cells is illustrated by a detailed account of the determination of a "leaf-time curve," *i.e.*, the variation in the intensity of the light within a forest as the trees come into leaf compared with that in open country. The necessity of proper temperature control, and of colour filters, the asymptotic character of the light intensity-current curve, the effect of resistance in the external circuit, and the advisability of careful calibration, and of repeating this at intervals in view of the fact that in some cells there may be a diminution of 40 % in sensitivity in six months, are all emphasised. C. A. S.

See also Abstracts 1626, 1723, 1755.

PIEZOELECTRICITY.

1752. Action of Radium and X-Rays on Piezoelectric Quartz. Franziska Seidl. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 9–10. *pp.* 467–469, 1933.—Experiments with five different plates of piezoelectric quartz which were exposed to radium and X-rays indicated only small changes of the piezoelectric constant which were, perhaps, of the same magnitude as the sources of error, but on the whole were in the sense of increase. Former investigations have shown a considerable rise in the value of the piezoelectric constant through the action of radium and X-rays in a specimen of quartz which possessed a notably low piezoelectric constant. J. J. S.

1753. Temperature Coefficient, Form and Amplitude of Oscillation of a Piezoelectric Oscillator. H. Straubel. *Phys. Zeits.* 35. *pp.* 179–181, *March* 1, 1934.—An interferometer method is used to measure the temperature coefficient of a piezoelectric oscillator and to obtain the amplitude of the oscillations. It is shown that the temperature coefficient varies with the angle between the normal to the plate and the optic axis, being zero for a certain orientation. Interference fringes show the type of vibration, which differ for the positive and negative quadrants of the crystal. Further, the patterns show that the amplitude of the oscillation increases as the potential increases. H. M. B.

See also Abstract 1476.

THERMIONICS.

1754. Approach to an Explanation of the Surface Work Functions of Pure Metals. J. F. Chittum. *J. Phys. Chem.* 38. *pp.* 79–84, *Jan.*, 1934.—The following principles are used by the author as guides for his approach to an explanation of the network function of pure metals. (1) The electrons should be considered as more or less in a condition of equiblibrium in a field of force characteristic of the crystal. (2) The Langmuir modification of the Schottky principle should be useful providing the distance x_0 is identified with some quantity other than the distance between the atoms. (3) The network functions should be independent of temperature. (4) The hypothesis should allow the calculation of the electrostatic potential energy constants for the various metals. A study of these principles leads to the hypothesis that the slope of the force-distance parabola is to be identified with the lattice energy of the metal crystal and can be assumed to be equal to a constant times the electrostatic potential energy of the crystal. Calculations are then made of the potential energy constants of a score of metals, starting from the compressibilities of the metals and using the principles developed by J. J. Thomson. The agreement between the calculated values and those found by various experimental methods is remarkably good. A. W.

1755. Dependence of Work-Function on Temperature for a Barium-Nickel Surface, Investigated Photoelectrically. R. Suhrmann and R. Deponte. *Zeits. f. Physik*, 86. 9–10. *pp*. 615–634, *Nov*. 28, 1933.—Measurements were carried out on the total photoelectric emission from surfaces of Ba on Ni under illumination by a black-body source. Referring to the formula $i_p = M\cdot T^2\cdot e^{-\frac{e_0}{kT}\cdot\psi(\Theta,\,\vartheta)}$ where i_p is the total photoelectric emission, the value of the work-function $\psi\ (\Theta, \vartheta)$ and that of the constant M were found for different values of T the temperature of the source, Θ the amount of Ba (which was less than sufficient to form a continuous monomolecular layer), and ϑ the temperature of the Ba surface. In order to separate the photoelectric emission from the thermionic emission the illumination was made intermittent and the photoelectric current applied to a capacity-coupled amplifier; the current was measured by balancing it against the current from a photocell, connected in parallel and similarly illuminated intermittently by a known light-intensity. The function $\psi\ (\Theta, \vartheta)$ increases linearly with ϑ; the temperature coefficient decreases as Θ increases and for a continuous-monomolecular Ba layer becomes negligible. The constant M is independent of temperature and practically independent of Θ. The results thus confirm the hypothesis—that the work-function varies linearly—advanced to explain the variation under certain conditions of the supposed universal constant A in Richardson's formula $i = A\cdot T^2\cdot e^{-\frac{e_0}{kT}\cdot\psi}$ for thermionic emission. This hypothesis cannot be tested directly by experiments on thermionic emission. The values of the temperature coefficient calculated from these results agrees with that calculated from the variations found in the value of A for thoriated tungsten kathodes. D. H. F.

1756. Measurement of the Townsend Coefficients for Ionisation by Collision. F. H. Sanders. *Phys. Rev.* 44. *pp*. 1020–1024, *Dec*. 15, 1933.—The photoelectric current between parallel plates in dry air was measured as a function of plate distance for constant field strength and pressure over plate distances ranging from 1 to 7 cm. and at a pressure of 1 mm. of mercury. The simple Townsend relation $i = i_0\epsilon^{\alpha d}$ was found to give excellent agreement for values X/p from 40 to 110. The least squares values of α/p plotted as a function of X/p lie on a smooth curve which does not fit either the equation $\alpha/p = N\epsilon^{-NV_0p/X}$ suggested by Townsend, nor the empirical relation $\alpha/p = A\epsilon^{bX/p}$, found by the writer to hold for values of X/p from 20 to 36·5. Voltages and plate distances were measured to within 1/10 of 1 % and pressures to 1/2 of 1 % or better. For X/p's from 120 to 160 the current was found to increase with plate distance more rapidly than the simple exponential relation would indicate, as was observed by Townsend for plate distances less than 1 cm. at much greater X/p's. The early appearance of this deviation may be ascribed to the greater sensitivity given by larger plate distances. Both of the relations suggested by Townsend: $i = i_0(\alpha - \beta)\epsilon^{(\alpha-\beta)d}/[\alpha - \beta\epsilon^{(\alpha-\beta)d}]$, which was derived on the assumption that each positive ion produces β new pairs of ions by collision in 1 cm of path, and $i = i_0\epsilon^{\alpha d}/[1 - \gamma(\epsilon^{\alpha d} - 1)]$, which assumes γ new electrons liberated by each positive ion which strikes the kathode, fit the experimental curves equally well. The values of β/p were observed to increase with X/p as found by Townsend for higher X/p's. The coefficient γ, which is approximately equal to β/α, was observed to increase only very slightly over this small range of X/p's. [See Abstract 5209 (1932).] AUTHOR.

1757. Determination of External Exit-Work. F. Rother and H. Bomke. *Zeits. f. Physik*, 87. 11–12. *pp.* 806–809, *Feb.* 19, 1934.—Referring to their recently published paper [see Abstract 392 (1934)] on theoretical considerations relating to the calculation of the normal exit-work from simple material constants, the authors find that the experimental results of electron diffraction cannot be used for the ascertainment of the external exit-work. In connection with the earlier given formulæ it is noted that for the metals of higher valency the effective number of the free conduction electrons apportioned on the average to each metal atom cannot vary much from unity. A new experimental determination of the normal exit-work in zinc gave practically full agreement of the value obtained (3·68 volts) with that calculated by the given formula. J. J. S.

1758. Electron-Microscopic Observations on the Migration of Emitting Material on Oxide Kathodes. E. F. Richter. *Zeits. f. Physik*, 86. 11–12. *pp.* 697–709, *Dec.* 7, 1933.—An explanation is offered of the "reversed images" of oxide kathodes produced by electron microscopes employing magnetic or electrostatic focussing on the assumption that metallic Ba is the origin of the electron emission. It is shown that the reversal is not due to disturbances of the electric field at the emitting surface but to the migration of emitting material on the kathode (Ni or Pt foil). By suitable choice of conditions the reversal may be overcome. A series of photographs illustrate the nature of "image reversal."

H. J. H. S.

1759. Diffusion of Positive Ions of Salts through Copper, Silver and Gold at High Temperatures. J. Cichocki. *Ann. de Physique*, 20. *pp.* 478–517, *Dec.*, 1933.—The salt is enclosed in a leaf of Cu, Ag or Au and this is placed on a heated platinum electrode. After a certain time, positive ions are emitted and are accelerated by the application of a p.d. and analysed by a mass spectrograph. Analysis shows that the ions emitted are the metallic ions of the salts and metals used and also complex ions; these latter are combinations of the metals of the salts with the metals of the leaves or even with the platinum of the electrode. The ions are found to suffer a loss of energy in escaping. To interpret experimental results, the hypothesis of the emission of large unstable ions must be assumed. H. M. B.

See also Abstracts 1643, 1644, 1685, 1723.